

# LM25101 3A、2A 和 1A 80V 半桥栅极驱动器

## 1 特性

- 独立的高侧和低侧驱动器逻辑输入
- 自举电源电压高达 100V DC
- 可驱动高侧和低侧 N 沟道金属氧化物半导体场效应晶体管 (MOSFET)
- 短暂传播时间 (典型值为 25ns)
- 可以 8ns 的上升和下降时间驱动 1000pF 负载
- 优异的传播延迟匹配 (典型值为 3ns)
- 支持电源轨欠压锁定
- 低功耗
- 与 HIP2100 和 HIP2101 引脚兼容

## 2 应用

- 由电机控制的驱动器
- 半桥和全桥电源转换器
- 同步降压转换器
- 双开关正向电源转换器
- 有源钳位正激转换器
- 48V 服务器电源
- 太阳能 DC-DC 和 DC-AC 转换器

## 3 说明

LM25101 高电压栅极驱动器专为驱动采用同步降压或半桥配置的高侧和低侧 N 沟道 MOSFET 而设计。版本 A 提供高达 3A 的栅极驱动，而版本 B 和 C 分别提供 2A 和 1A 的栅极驱动。输出由 TTL 输入阈值独立控制。该器件集成了一个高压二极管，用于对高侧栅极驱动自举电容进行充电。稳健可靠的电平转换器同时拥有高运行速度和低功耗特性，并且可提供从控制逻辑到高侧栅极驱动器的干净电平转换。该器件在低侧和高侧电源轨上提供了欠压锁定功能。

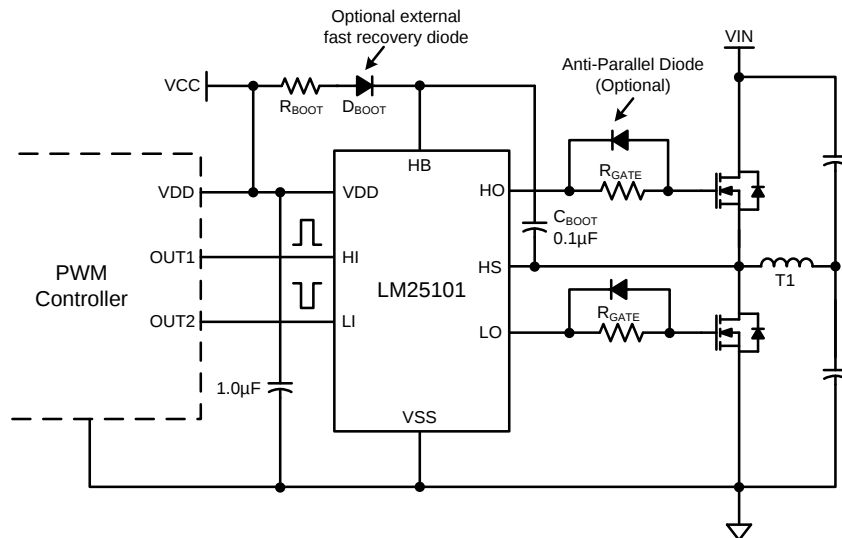
这些器件采用标准 8 引脚 SOIC、8 引脚 SO-PowerPAD、8 引脚 WSON、10 引脚 WSON 以及 8 引脚 MOSP PowerPAD 封装。

器件信息<sup>(1)</sup>

| 器件型号    | 封装                | 封装尺寸 (标称值)     |
|---------|-------------------|----------------|
| LM25101 | MSOP PowerPAD (8) | 3mm x 3mm      |
|         | WSON (8)          | 4mm x 4mm      |
|         | WSON (10)         | 4mm x 4mm      |
|         | SO PowerPAD (8)   | 3.9mm x 4.89mm |
|         | SOIC (8)          | 3.91mm x 4.9mm |

(1) 要了解所有可用封装，请见数据表末尾的可订购产品附录。

简化应用示意图



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## 目录

|          |                                        |           |           |                                       |           |
|----------|----------------------------------------|-----------|-----------|---------------------------------------|-----------|
| <b>1</b> | <b>特性</b>                              | <b>1</b>  | 8.3       | Feature Description                   | 12        |
| <b>2</b> | <b>应用</b>                              | <b>1</b>  | 8.4       | Device Functional Modes               | 13        |
| <b>3</b> | <b>说明</b>                              | <b>1</b>  | <b>9</b>  | <b>Application and Implementation</b> | <b>14</b> |
| <b>4</b> | <b>修订历史记录</b>                          | <b>2</b>  | 9.1       | Application Information               | 14        |
| <b>5</b> | <b>Device Options</b>                  | <b>3</b>  | 9.2       | Typical Application                   | 14        |
| <b>6</b> | <b>Pin Configuration and Functions</b> | <b>3</b>  | <b>10</b> | <b>Power Supply Recommendations</b>   | <b>16</b> |
| <b>7</b> | <b>Specifications</b>                  | <b>4</b>  | <b>11</b> | <b>Layout</b>                         | <b>17</b> |
| 7.1      | Absolute Maximum Ratings               | 4         | 11.1      | Layout Guidelines                     | 17        |
| 7.2      | ESD Ratings                            | 5         | 11.2      | Layout Example                        | 18        |
| 7.3      | Recommended Operating Conditions       | 5         | <b>12</b> | <b>器件和文档支持</b>                        | <b>19</b> |
| 7.4      | Thermal Information                    | 5         | 12.1      | 接收文档更新通知                              | 19        |
| 7.5      | Electrical Characteristics             | 6         | 12.2      | 社区资源                                  | 19        |
| 7.6      | Switching Characteristics              | 7         | 12.3      | 商标                                    | 19        |
| 7.7      | Typical Characteristics                | 8         | 12.4      | 静电放电警告                                | 19        |
| <b>8</b> | <b>Detailed Description</b>            | <b>12</b> | 12.5      | Glossary                              | 19        |
| 8.1      | Overview                               | 12        | <b>13</b> | <b>机械、封装和可订购信息</b>                    | <b>19</b> |
| 8.2      | Functional Block Diagram               | 12        |           |                                       |           |

## 4 修订历史记录

注：之前版本的页码可能与当前版本有所不同。

| Changes from Revision B (March 2013) to Revision C                                   | Page |
|--------------------------------------------------------------------------------------|------|
| • 已添加 <b>ESD</b> 额定值表，特性 描述部分，器件功能模式，应用和实施部分，电源相关建议部分，布局部分，器件和文档支持部分以及机械、封装和可订购信息部分。 | 1    |
| • Added <b>Thermal Information</b> table                                             | 5    |

| Changes from Original (March 2013) to Revision A | Page |
|--------------------------------------------------|------|
| • 已更改 国家半导体数据表的布局至 TI 格式                         | 1    |

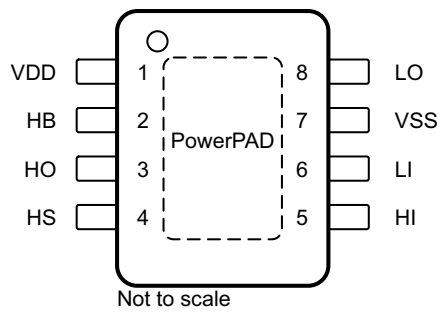
## 5 Device Options

**Table 1. Input/Output Options**

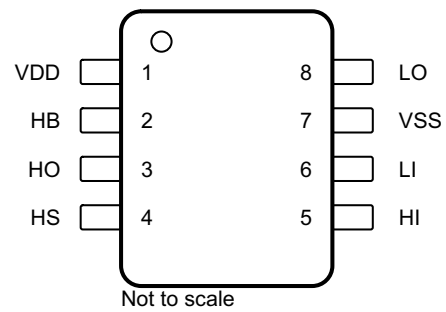
| Part Number | Input Thresholds | Peak Output Current |
|-------------|------------------|---------------------|
| LM25101A    | TTL              | 3 A                 |
| LM25101B    | TTL              | 2 A                 |
| LM25101C    | TTL              | 1 A                 |

## 6 Pin Configuration and Functions

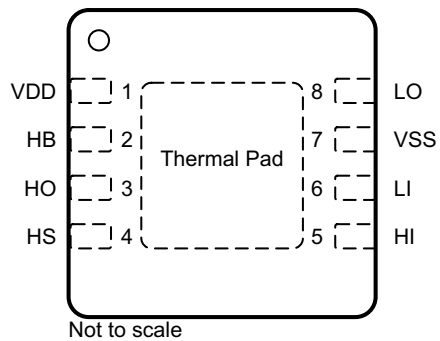
**DGN and DDA Packages  
8-Pin MSOP and SO PowerPAD  
Top View**



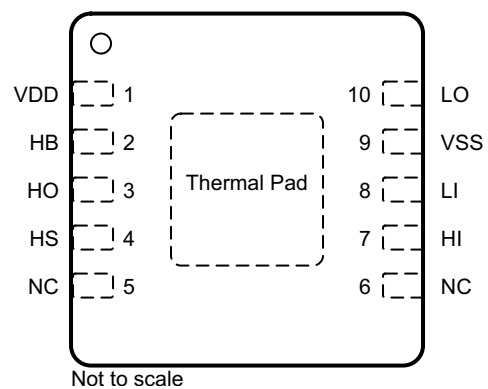
**D Package  
8-Pin SOIC  
Top View**



**NGT Package  
8-Pin WSON  
Top View**



**DPR Package  
10-Pin WSON  
Top View**



## Pin Functions

| NAME        | PIN              |             |              |                |      | TYPE | DESCRIPTION                                                                                                                                                                                                    |
|-------------|------------------|-------------|--------------|----------------|------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | MSOP<br>PowerPAD | WSON<br>(8) | WSON<br>(10) | SO<br>PowerPAD | SOIC |      |                                                                                                                                                                                                                |
| HB          | 2                | 2           | 2            | 2              | 2    | PWR  | High-side gate driver bootstrap rail. Connect the positive terminal of the bootstrap capacitor to HB and the negative terminal to HS. The bootstrap capacitor should be placed as close to the IC as possible. |
| HI          | 5                | 5           | 7            | 5              | 5    | I    | High-side driver control input. The LM25101 inputs have TTL type thresholds. Unused inputs should be tied to ground and not left open.                                                                         |
| HO          | 3                | 3           | 3            | 3              | 3    | O    | High-side gate driver output. Connect to the gate of high-side MOSFET with a short, low inductance path.                                                                                                       |
| HS          | 4                | 4           | 4            | 4              | 4    | GND  | High-side MOSFET source connection. Connect to the bootstrap capacitor negative terminal and the source of the high-side MOSFET.                                                                               |
| LI          | 6                | 6           | 8            | 6              | 6    | I    | Low-side driver control input. The LM25101 inputs have TTL type thresholds. Unused inputs should be tied to ground and not left open.                                                                          |
| LO          | 8                | 8           | 10           | 8              | 8    | O    | Low-side gate driver output. Connect to the gate of the low-side MOSFET with a short, low inductance path.                                                                                                     |
| NC          | —                | —           | 5, 6         | —              | —    | —    | No connection                                                                                                                                                                                                  |
| VDD         | 1                | 1           | 1            | 1              | 1    | PWR  | Positive gate drive supply. Locally decouple to VSS using a low ESR and ESL capacitor located as close to the IC as possible.                                                                                  |
| VSS         | 7                | 7           | 9            | 7              | 7    | GND  | Ground return. All signals are referenced to this ground.                                                                                                                                                      |
| Thermal Pad | PowerPAD         | Thermal Pad | Thermal Pad  | PowerPAD       | —    | —    | Solder to the ground plane under the IC to aid in heat dissipation. <sup>(1)</sup>                                                                                                                             |

- (1) TI recommends that the exposed thermal pad on the bottom of the applicable packages is soldered to ground plane of the PCB, and the ground plane should extend out from beneath the IC to help dissipate heat.

## 7 Specifications

### 7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                                | MIN            | MAX            | UNIT |
|--------------------------------|----------------|----------------|------|
| VDD to VSS                     | −0.3           | 18             | V    |
| HB to HS                       | −0.3           | 18             | V    |
| LI or HI Input                 | −0.3           | $V_{DD} + 0.3$ | V    |
| LO Output                      | −0.3           | $V_{DD} + 0.3$ | V    |
| HO Output                      | $V_{HS} - 0.3$ | $V_{HB} + 0.3$ | V    |
| HS to VSS <sup>(2)</sup>       | −5             | 100            | V    |
| HB to VSS                      |                | 100            | V    |
| Junction temperature, $T_J$    |                | 150            | °C   |
| Storage temperature, $T_{stg}$ | −55            | 150            | °C   |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. For performance limits and associated test conditions, see the *Electrical Characteristics* tables.
- (2) In the application the HS node is clamped by the body diode of the external lower N-MOSFET, therefore the HS node will generally not exceed −1 V. However, in some applications, board resistance and inductance may result in the HS node exceeding this stated voltage transiently. If negative transients occur, the HS voltage must never be more negative than  $V_{DD} - 15$  V. For example, if  $V_{DD} = 10$  V, the negative transients at HS must not exceed −5 V.

## 7.2 ESD Ratings

|                                     |                                                                                |                             | VALUE | UNIT |
|-------------------------------------|--------------------------------------------------------------------------------|-----------------------------|-------|------|
| $V_{(ESD)}$ Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>              | All pins except 2, 3, and 4 | ±2000 | V    |
|                                     |                                                                                | Pins 2, 3, and 4            | ±1000 |      |
|                                     | Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup> |                             | ±250  |      |
|                                     | Machine model (MM)                                                             |                             | ±100  |      |

(1) The Human Body Model (HBM) is a 100-pF capacitor discharged through a 1.5-kΩ resistor into each pin.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

## 7.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

|          |                      |     | MIN          | MAX            | UNIT |
|----------|----------------------|-----|--------------|----------------|------|
| $V_{DD}$ | Supply voltage       | VDD | 9            | 14             | V    |
| $V_{HS}$ | Voltage              | HS  | –1           | $100 - V_{DD}$ | V    |
| $V_{HB}$ | Voltage              | HB  | $V_{HS} + 8$ | $V_{HS} + 14$  | V    |
|          | HS slew rate         |     |              | 50             | V/ns |
| $T_J$    | Junction temperature |     | –40          | 125            | °C   |

## 7.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                              | LM25101A, LM25101B |                   |            |            | LM25101C |            |                     | UNIT |
|-------------------------------|----------------------------------------------|--------------------|-------------------|------------|------------|----------|------------|---------------------|------|
|                               |                                              | D (SOIC)           | DDA (SO PowerPAD) | NGT (WSON) | DPR (WSON) | D (SOIC) | DPR (WSON) | DGN (MSOP PowerPAD) |      |
|                               |                                              | 8 PINS             | 8 PINS            | 8 PINS     | 10 PINS    | 8 PINS   | 10 PINS    | 8 PINS              |      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance       | 108.2              | 46.1              | 38.2       | 37.8       | 111.5    | 39.8       | 54.1                | °C/W |
| $R_{\theta JC(top)}$          | Junction-to-case (top) thermal resistance    | 50.6               | 53.5              | 36.3       | 35.8       | 54.2     | 39.1       | 55.9                | °C/W |
| $R_{\theta JB}$               | Junction-to-board thermal resistance         | 49.1               | 13.8              | 15.2       | 15.0       | 52.3     | 17.1       | 15.1                | °C/W |
| $\Psi_{JT}$                   | Junction-to-top characterization parameter   | 7.6                | 4.2               | 0.3        | 0.3        | 9.0      | 0.4        | 2.4                 | °C/W |
| $\Psi_{JB}$                   | Junction-to-board characterization parameter | 48.5               | 13.9              | 15.4       | 15.3       | 51.7     | 17.3       | 15.1                | °C/W |
| $R_{\theta JC(bot)}$          | Junction-to-case (bottom) thermal resistance | —                  | 3.9               | 4.5        | 4.4        | —        | 6.1        | 4.6                 | °C/W |

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

## 7.5 Electrical Characteristics

Typical values apply for  $T_J = 25^\circ\text{C}$  only. Minimum and maximum limits apply for  $T_J = -40^\circ\text{C}$  to  $125^\circ\text{C}$ .<sup>(1)</sup> Unless otherwise specified,  $V_{DD} = V_{HB} = 12\text{ V}$ ,  $V_{SS} = V_{HS} = 0\text{ V}$ , No Load on LO or HO.

| PARAMETER                       |                               | TEST CONDITIONS                                                                                  | MIN       | TYP  | MAX  | UNIT          |
|---------------------------------|-------------------------------|--------------------------------------------------------------------------------------------------|-----------|------|------|---------------|
| <b>SUPPLY CURRENTS</b>          |                               |                                                                                                  |           |      |      |               |
| $I_{DD}$                        | VDD quiescent current         | $V_{LI} = V_{HI} = 0\text{ V}$                                                                   |           | 0.25 | 0.4  | mA            |
| $I_{DDO}$                       | VDD operating current         | $f = 500\text{ kHz}$                                                                             |           | 2.0  | 3    | mA            |
| $I_{HB}$                        | Total HB quiescent current    | $V_{LI} = V_{HI} = 0\text{ V}$                                                                   |           | 0.06 | 0.2  | mA            |
| $I_{HBO}$                       | Total HB operating current    | $f = 500\text{ kHz}$                                                                             |           | 1.6  | 3    | mA            |
| $I_{HBS}$                       | HB to VSS current (quiescent) | $V_{HS} = V_{HB} = 100\text{ V}$                                                                 |           | 0.1  | 10   | $\mu\text{A}$ |
| $I_{HBSO}$                      | HB to VSS current (operating) | $f = 500\text{ kHz}$                                                                             |           | 0.4  |      | mA            |
| <b>INPUT PINS</b>               |                               |                                                                                                  |           |      |      |               |
| $V_{IL}$                        | Input voltage threshold       | Rising Edge                                                                                      | 1.3       | 1.8  | 2.3  | V             |
| $V_{IHYS}$                      | Input voltage hysteresis      |                                                                                                  |           | 50   |      | mV            |
| $R_I$                           | Input pulldown resistance     |                                                                                                  | 100       | 200  | 400  | k $\Omega$    |
| <b>UNDER VOLTAGE PROTECTION</b> |                               |                                                                                                  |           |      |      |               |
| $V_{DDR}$                       | VDD rising threshold          |                                                                                                  | 6.0       | 6.9  | 7.4  | V             |
| $V_{DDH}$                       | VDD threshold hysteresis      |                                                                                                  |           | 0.5  |      | V             |
| $V_{HBR}$                       | HB rising threshold           |                                                                                                  | 5.7       | 6.6  | 7.1  | V             |
| $V_{HBH}$                       | HB threshold hysteresis       |                                                                                                  |           | 0.4  |      | V             |
| <b>BOOT STRAP DIODE</b>         |                               |                                                                                                  |           |      |      |               |
| $V_{DL}$                        | Low-current forward voltage   | $I_{VDD-HB} = 100\text{ }\mu\text{A}$                                                            |           | 0.52 | 0.85 | V             |
| $V_{DH}$                        | High-current forward voltage  | $I_{VDD-HB} = 100\text{ mA}$                                                                     |           | 0.8  | 1    | V             |
| $R_D$                           | Dynamic resistance            | $I_{VDD-HB} = 100\text{ mA}$                                                                     |           | 1.0  | 1.65 | $\Omega$      |
| <b>LO AND HO GATE DRIVER</b>    |                               |                                                                                                  |           |      |      |               |
| $V_{OL}$                        | Low-level output voltage      | $I_{HO} = I_{LO} = 100\text{ mA}$                                                                | A version | 0.12 | 0.25 | V             |
|                                 |                               |                                                                                                  | B version | 0.16 | 0.4  |               |
|                                 |                               |                                                                                                  | C version | 0.28 | 0.65 |               |
| $V_{OH}$                        | High-level output voltage     | $I_{HO} = I_{LO} = 100\text{ mA}$<br>$V_{OH} = V_{DD} - V_{LO}$ or<br>$V_{OH} = V_{HB} - V_{HO}$ | A version | 0.24 | 0.45 | V             |
|                                 |                               |                                                                                                  | B version | 0.28 | 0.60 |               |
|                                 |                               |                                                                                                  | C version | 0.60 | 1.10 |               |
| $I_{OHL}$                       | Peak pullup current           | HO, $V_{LO} = 0\text{ V}$                                                                        | A version | 3    |      | A             |
|                                 |                               |                                                                                                  | B version | 2    |      |               |
|                                 |                               |                                                                                                  | C version | 1    |      |               |
| $I_{OLL}$                       | Peak pulldown current         | HO, $V_{LO} = 12\text{ V}$                                                                       | A version | 3    |      | A             |
|                                 |                               |                                                                                                  | B version | 2    |      |               |
|                                 |                               |                                                                                                  | C version | 1    |      |               |

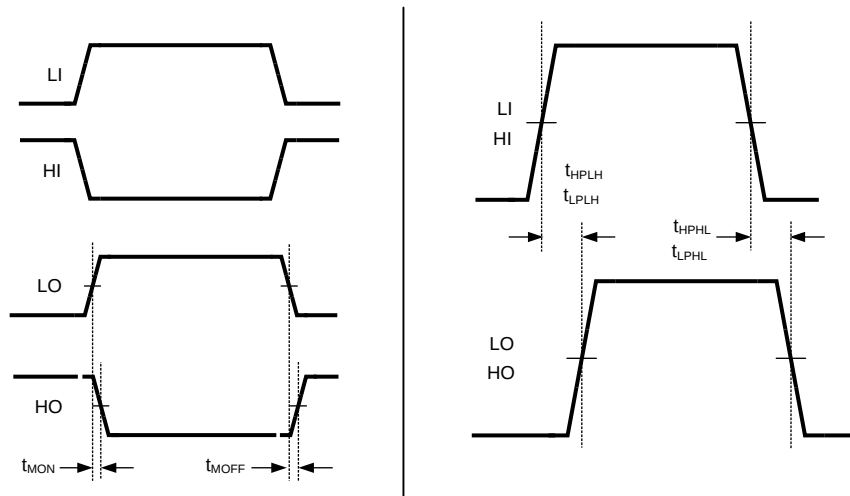
(1) Minimum and maximum limits are 100% production tested at  $25^\circ\text{C}$ . Limits over the operating temperature range are specified through correlation using Statistical Quality Control (SQC) methods. Limits are used to calculate Average Outgoing Quality Level (AOQL).

## 7.6 Switching Characteristics

Typical values apply for  $T_J = 25^\circ\text{C}$  only. Minimum and maximum limits apply for  $T_J = -40^\circ\text{C}$  to  $125^\circ\text{C}$ .<sup>(1)</sup> Unless otherwise specified,  $V_{DD} = V_{HB} = 12\text{ V}$ ,  $V_{SS} = V_{HS} = 0\text{ V}$ , No Load on LO or HO.

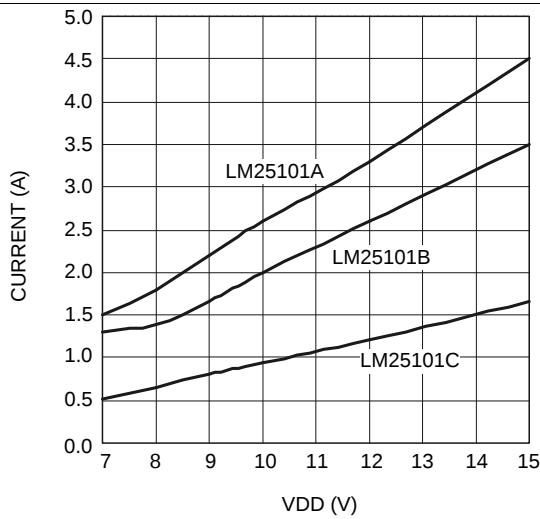
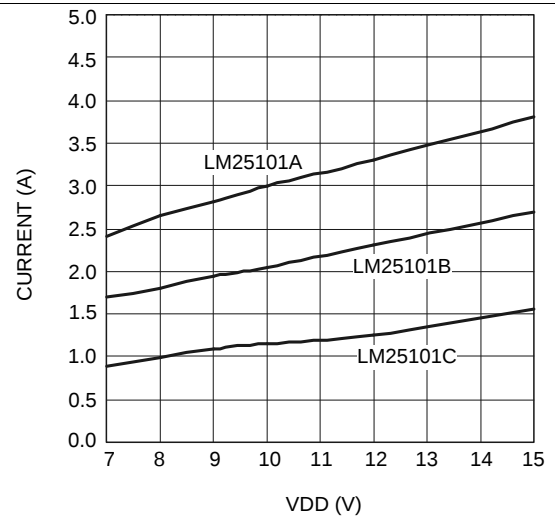
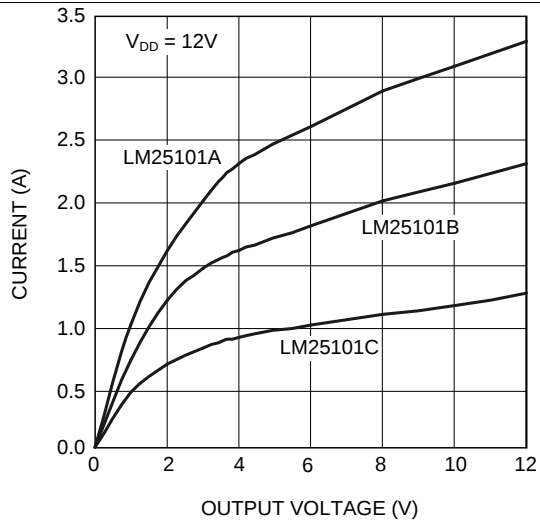
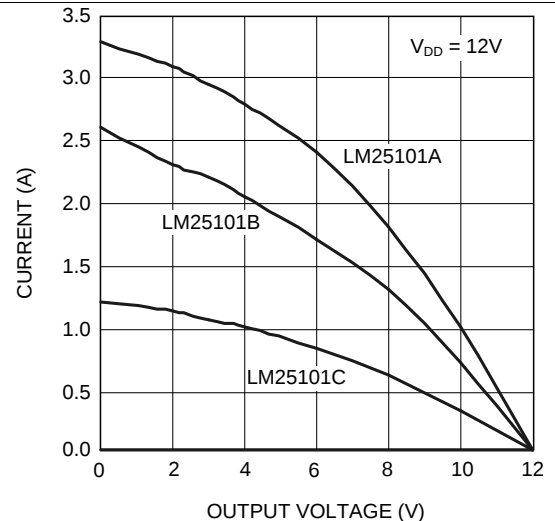
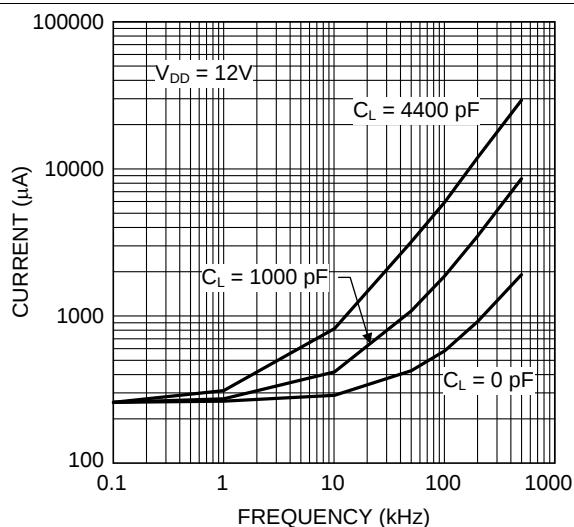
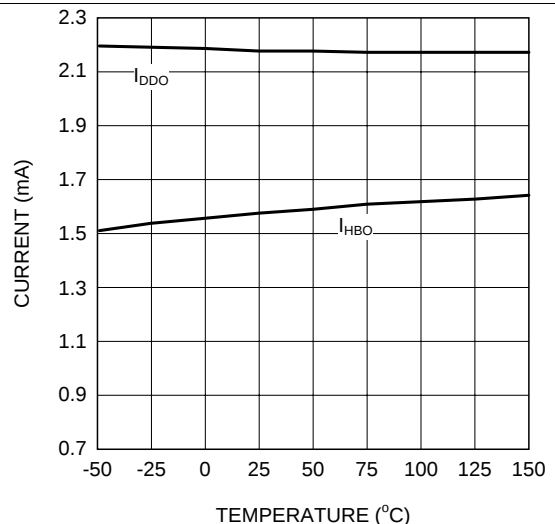
| PARAMETER        | TEST CONDITIONS                                      | MIN                                           | TYP       | MAX | UNIT |
|------------------|------------------------------------------------------|-----------------------------------------------|-----------|-----|------|
| $t_{LPHL}$       | LO turnoff propagation delay                         |                                               | 22        | 56  | ns   |
| $t_{LPLH}$       | LO turnon propagation delay                          |                                               | 26        | 56  | ns   |
| $t_{HPHL}$       | HO turnoff propagation delay                         |                                               | 22        | 56  | ns   |
| $t_{HPLH}$       | HO turnon propagation delay                          |                                               | 26        | 56  | ns   |
| $t_{MON}$        | Delay matching                                       |                                               | 4         | 10  | ns   |
| $t_{MOFF}$       | Delay matching                                       |                                               | 4         | 10  | ns   |
| $t_{RC}, t_{FC}$ | Either output rise and fall time                     |                                               | 8         |     | ns   |
| $t_R$            | Output rise time (3 V to 9 V)                        | $C_L = 0.1\text{ }\mu\text{F}$                | A version | 430 | ns   |
|                  |                                                      |                                               | B version | 570 |      |
|                  |                                                      |                                               | C version | 990 |      |
| $t_F$            | Output fall time (3 V to 9 V)                        | $C_L = 0.1\text{ }\mu\text{F}$                | A version | 260 | ns   |
|                  |                                                      |                                               | B version | 430 |      |
|                  |                                                      |                                               | C version | 715 |      |
| $t_{PW}$         | Minimum input pulse duration that changes the output |                                               | 50        |     | ns   |
| $t_{BS}$         | Bootstrap diode reverse recovery time                | $I_F = 100\text{ mA}$ , $I_R = 100\text{ mA}$ | 37        |     | ns   |

(1) Minimum and maximum limits are 100% production tested at  $25^\circ\text{C}$ . Limits over the operating temperature range are specified through correlation using Statistical Quality Control (SQC) methods. Limits are used to calculate Average Outgoing Quality Level (AOQL).

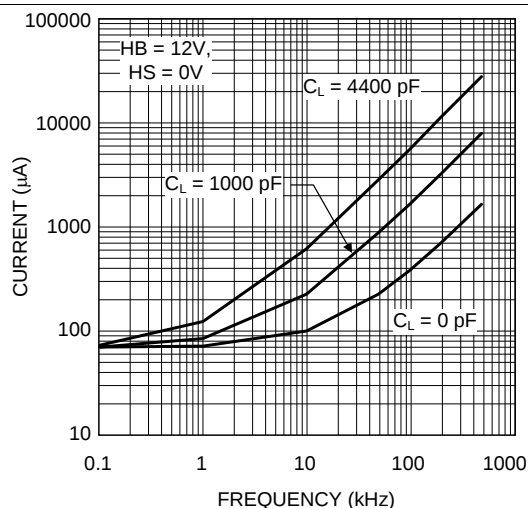


**Figure 1. Timing Diagram**

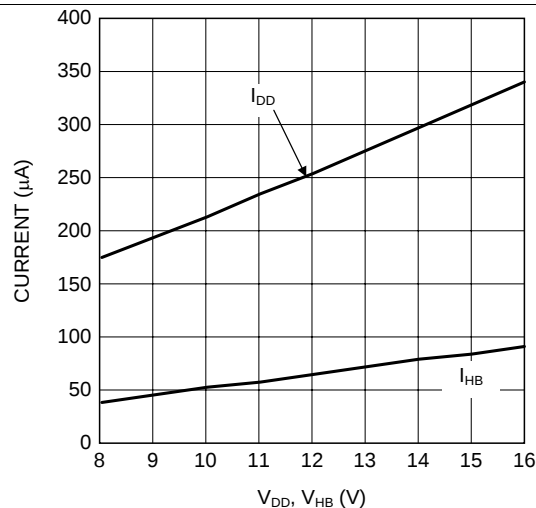
## 7.7 Typical Characteristics


**Figure 2. Peak Sourcing Current vs Supply Voltage**

**Figure 3. Peak Sinking Current vs Supply Voltage**

**Figure 4. Sink Current vs Output Voltage**

**Figure 5. Source Current vs Output Voltage**

**Figure 6. I<sub>DD</sub> vs Frequency**

**Figure 7. Operating Current vs Temperature**

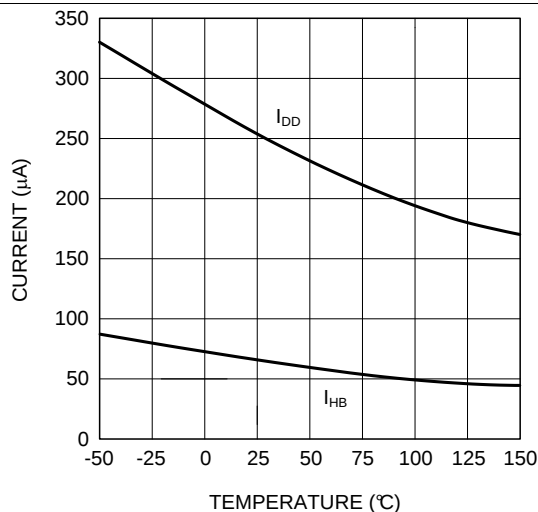
## Typical Characteristics (continued)



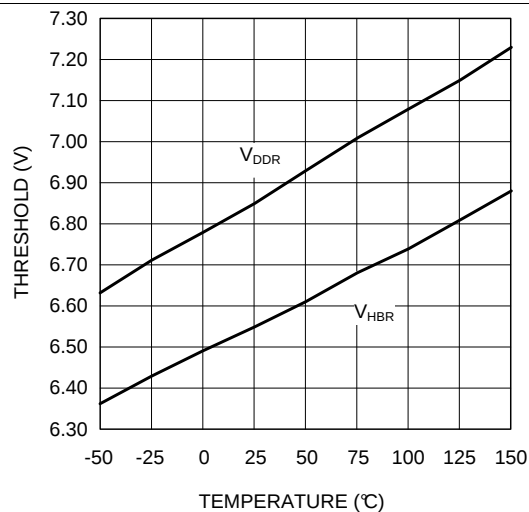
**Figure 8.  $I_{HB}$  vs Frequency**



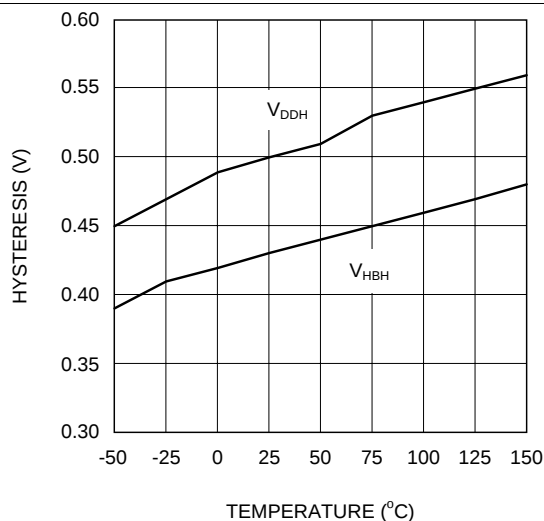
**Figure 9. Quiescent Current vs Supply Voltage**



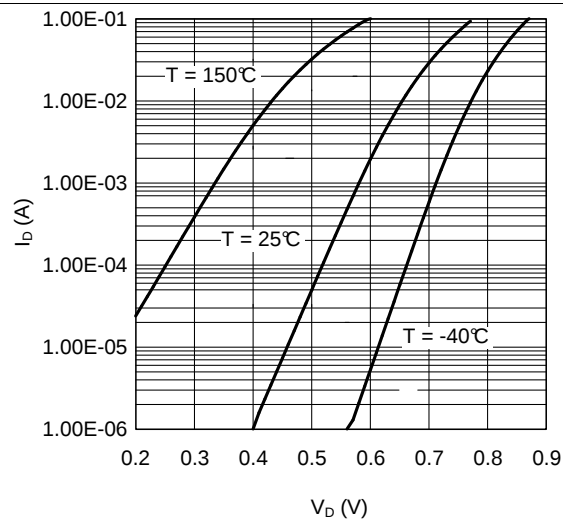
**Figure 10. Quiescent Current vs Temperature**



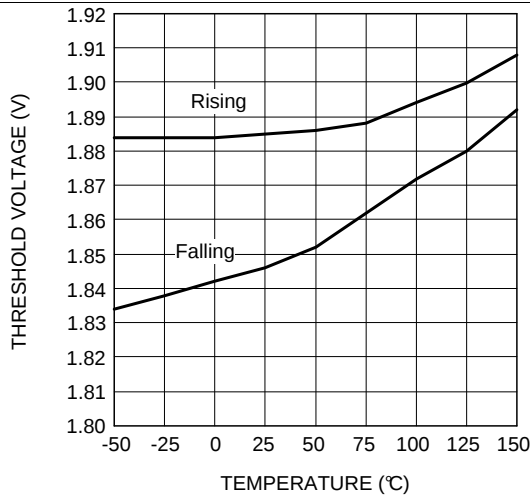
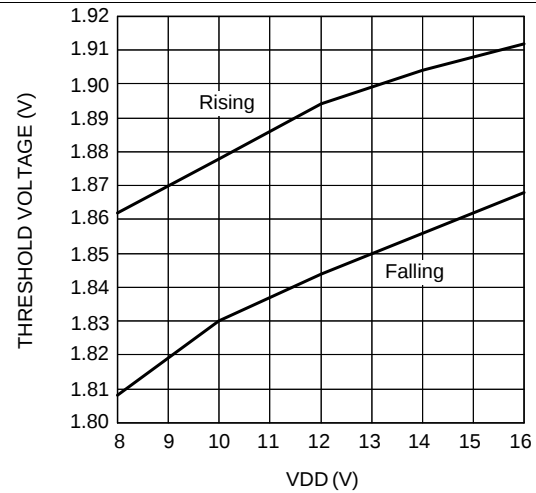
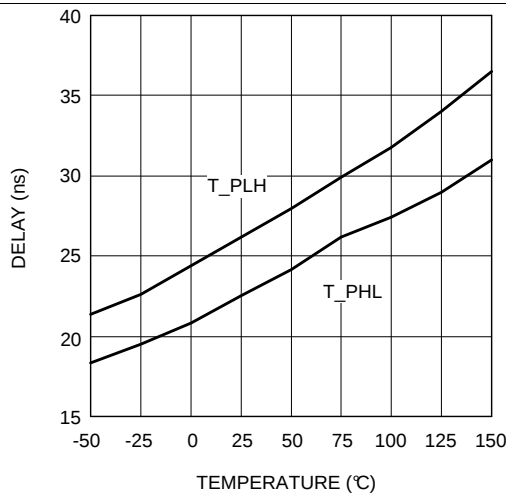
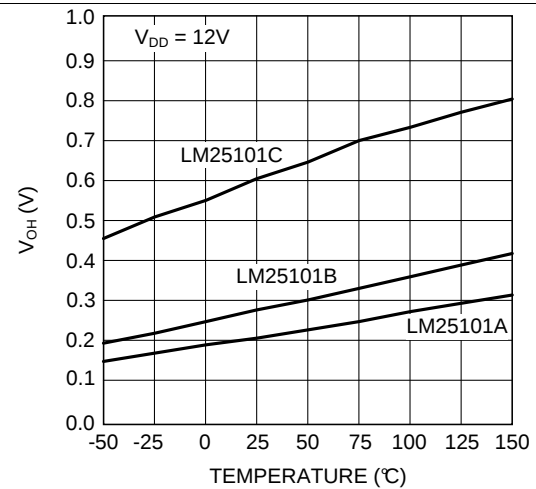
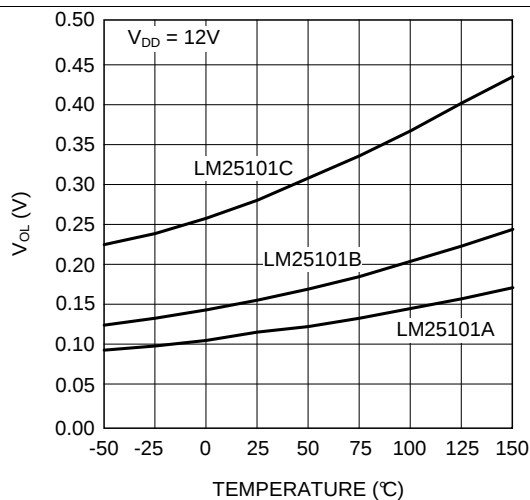
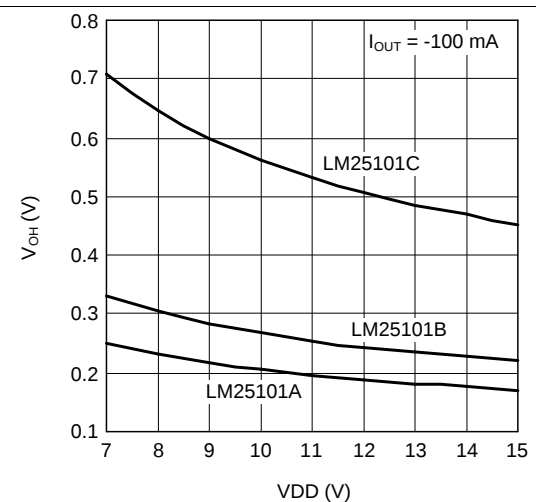
**Figure 11. Undervoltage Rising Thresholds vs Temperature**



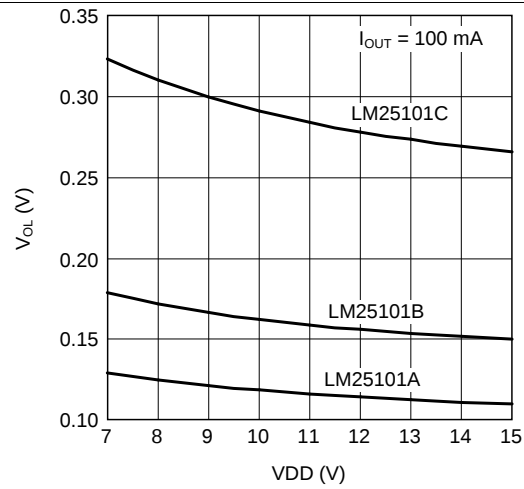
**Figure 12. Undervoltage Threshold Hysteresis vs Temperature**



**Figure 13. Bootstrap Diode Forward Voltage**

**Typical Characteristics (continued)**

**Figure 14. Input Threshold vs Temperature**

**Figure 15. Input Threshold vs Supply Voltage**

**Figure 16. Propagation Delay vs Temperature**

**Figure 17. LO and HO Gate Drive:  
High Level Output Voltage vs Temperature**

**Figure 18. LO and HO Gate Drive:  
Low Level Output Voltage vs Temperature**

**Figure 19. LO and HO Gate Drive:  
Output High Voltage vs Supply Voltage**

## Typical Characteristics (continued)



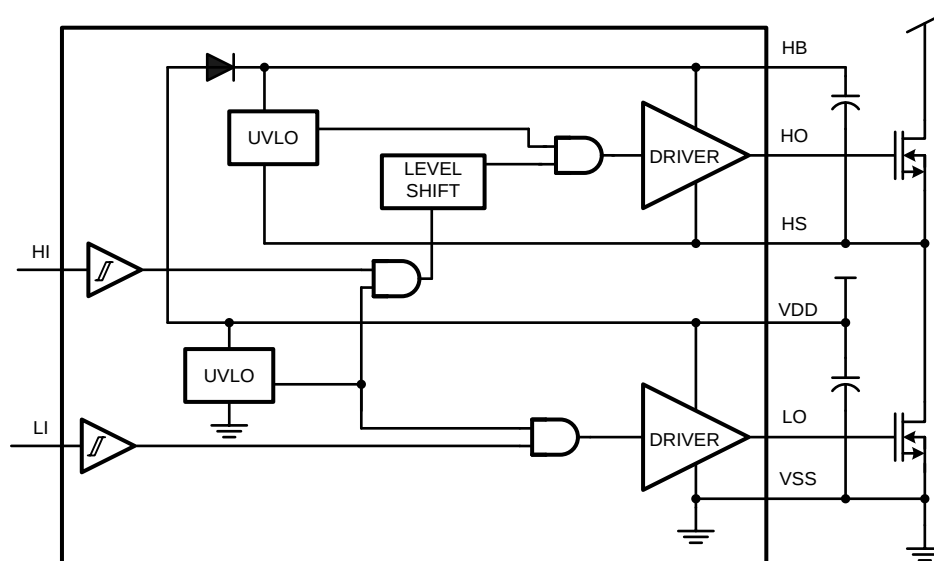
**Figure 20. LO and HO Gate Drive:  
Output Low Voltage vs Supply Voltage**

## 8 Detailed Description

### 8.1 Overview

To operate fast switching of power MOSFETs at high switching frequencies and to reduce associated switching losses, a powerful gate driver is employed between the PWM output of controller and the gates of the power semiconductor devices. Also, gate drivers are indispensable when it is impossible for the PWM controller to directly drive the gates of the switching devices. With the advent of digital power, this situation is often encountered because the PWM signal from the digital controller is often a 3.3 V logic signal which cannot effectively turn on a power switch. Level shift circuitry is needed to boost the 3.3-V signal to the gate-drive voltage (such as 12 V) in order to fully turn on the power device and minimize conduction losses. Traditional buffer drive circuits based on NPN or PNP bipolar transistors in totem-pole arrangement prove inadequate with digital power because they lack level-shifting capability. Gate drivers effectively combine both the level-shifting and buffer-drive functions. Gate drivers also find other needs such as minimizing the effect of high-frequency switching noise (by placing the high-current driver IC physically close to the power switch), driving gate-drive transformers and controlling floating power-device gates, reducing power dissipation and thermal stress in controllers by moving gate charge power losses from the controller into the driver.

### 8.2 Functional Block Diagram



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### 8.3 Feature Description

#### 8.3.1 Start-Up and UVLO

Both top and bottom drivers include UVLO protection circuitry which monitors the supply voltage ( $V_{DD}$ ) and bootstrap capacitor voltage ( $V_{HB-HS}$ ) independently. The UVLO circuit inhibits each output until sufficient supply voltage is available to turn on the external MOSFETs, and the built-in UVLO hysteresis prevents chattering during supply voltage variations. When the supply voltage is applied to the VDD pin of the LM25101, the top and bottom gates are held low until  $V_{DD}$  exceeds the UVLO threshold, typically about 6.9 V. Any UVLO condition on the bootstrap capacitor ( $V_{HB-HS}$ ) will only disable the high-side output (HO).

**Table 2. VDD UVLO Feature Logic Operation**

| CONDITION <sup>(1)</sup>                                    | HI | LI | HO | LO |
|-------------------------------------------------------------|----|----|----|----|
| $V_{DD} - V_{SS} < V_{DDR}$ during device start-up          | H  | L  | L  | L  |
| $V_{DD} - V_{SS} < V_{DDR}$ during device start-up          | L  | H  | L  | L  |
| $V_{DD} - V_{SS} < V_{DDR}$ during device start-up          | H  | H  | L  | L  |
| $V_{DD} - V_{SS} < V_{DDR}$ during device start-up          | L  | L  | L  | L  |
| $V_{DD} - V_{SS} < V_{DDR} - V_{DDH}$ after device start-up | H  | L  | L  | L  |
| $V_{DD} - V_{SS} < V_{DDR} - V_{DDH}$ after device start-up | L  | H  | L  | L  |
| $V_{DD} - V_{SS} < V_{DDR} - V_{DDH}$ after device start-up | H  | H  | L  | L  |
| $V_{DD} - V_{SS} < V_{DDR} - V_{DDH}$ after device start-up | L  | L  | L  | L  |

(1)  $V_{HB-HS} > V_{HBR}$

**Table 3. VHB-HS UVLO Feature Logic Operation**

| CONDITION <sup>(1)</sup>                              | HI | LI | HO | LO |
|-------------------------------------------------------|----|----|----|----|
| $V_{HB-HS} < V_{HBR}$ during device start-up          | H  | L  | L  | L  |
| $V_{HB-HS} < V_{HBR}$ during device start-up          | L  | H  | L  | H  |
| $V_{HB-HS} < V_{HBR}$ during device start-up          | H  | H  | L  | H  |
| $V_{HB-HS} < V_{HBR}$ during device start-up          | L  | L  | L  | L  |
| $V_{HB-HS} < V_{HBR} - V_{HBH}$ after device start-up | H  | L  | L  | L  |
| $V_{HB-HS} < V_{HBR} - V_{HBH}$ after device start-up | L  | H  | L  | H  |
| $V_{HB-HS} < V_{HBR} - V_{HBH}$ after device start-up | H  | H  | L  | H  |
| $V_{HB-HS} < V_{HBR} - V_{HBH}$ after device start-up | L  | L  | L  | L  |

(1)  $V_{DD} > V_{DDR}$

### 8.3.2 Level Shift

The level shift circuit is the interface from the high-side input to the high-side driver stage which is referenced to the switch node (HS). The level shift allows control of the HO output which is referenced to the HS pin and provides excellent delay matching with the low-side driver.

### 8.3.3 Output Stages

The output stages are the interface to the power MOSFETs in the power train. High slew rate, low resistance, and high peak current capability of both outputs allow for efficient switching of the power MOSFETs. The low-side output stage is referenced to VSS and the high-side is referenced to HS.

## 8.4 Device Functional Modes

The device operates in normal mode and UVLO mode. See [Start-Up and UVLO](#) for more information on UVLO operation mode. In normal mode when the  $V_{DD}$  and  $V_{HB-HS}$  are above UVLO threshold, the output stage is dependent on the states of the HI and LI pins. Unused inputs should be tied to ground and not left open.

**Table 4. INPUT and OUTPUT Logic Table**

| HI | LI | HO <sup>(1)</sup> | LO <sup>(2)</sup> |
|----|----|-------------------|-------------------|
| L  | L  | L                 | L                 |
| L  | H  | L                 | H                 |
| H  | L  | H                 | L                 |
| H  | H  | H                 | H                 |

(1) HO is measured with respect to the HS pin.

(2) LO is measured with respect to the VSS pin.

## 9 Application and Implementation

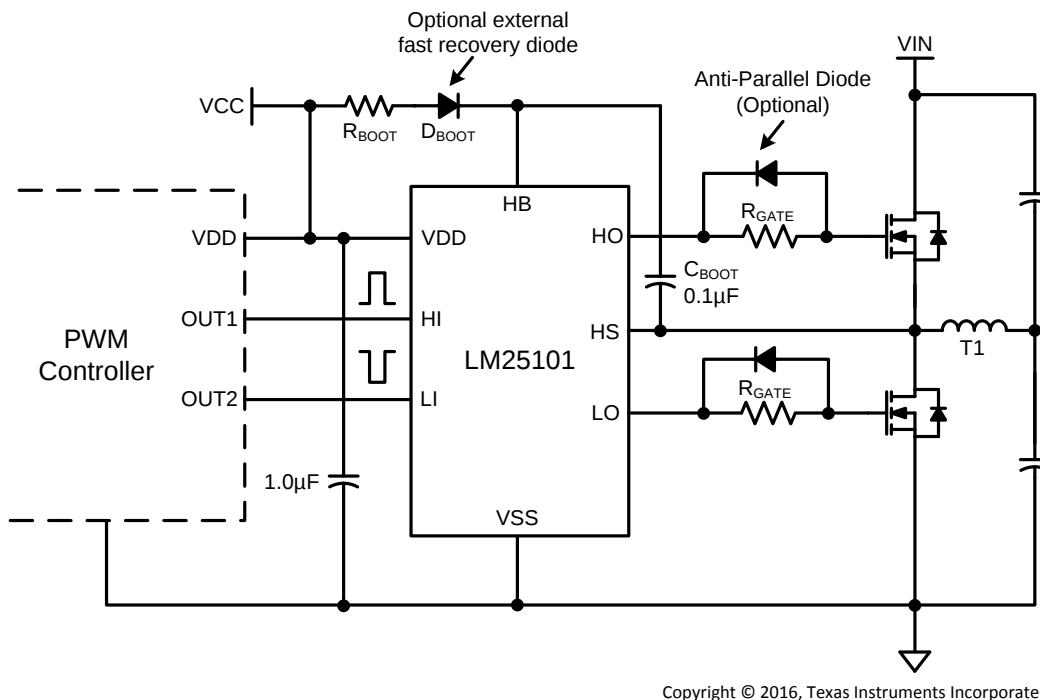
### NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 9.1 Application Information

The LM25101 is a high voltage gate driver designed to drive both the high-side and low-side N-Channel MOSFETs in a half or full bridge configuration or in a synchronous buck circuit. The floating high side driver is capable of operating with supply voltages up to 100 V. This allows for N-Channel MOSFETs control in half-bridge, full-bridge, push-pull, two switch forward, and active clamp topologies. The outputs are independently controlled. Each channel is controlled by its respective input pins (HI and LI), allowing full and independent flexibility to control the state (ON and OFF) of the output.

### 9.2 Typical Application



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**Figure 21. Application Diagram**

#### 9.2.1 Design Requirements

For this design example, use the parameters listed in [Table 5](#) as the input parameters.

**Table 5. Design Parameters**

| PARAMETER   | EXAMPLE VALUE       |
|-------------|---------------------|
| Gate driver | LM25101 (C version) |
| MOSFET      | CSD19534KCS         |
| $V_{DD}$    | 10 V                |
| $Q_G$       | 17 nC               |
| $f_{SW}$    | 500 kHz             |

## 9.2.2 Detailed Design Procedure

### 9.2.2.1 Selecting External Gate Driver Resistor

External gate driver resistor ( $R_{GATE}$ ) is sized to reduce ringing caused by parasitic inductances and capacitances and also to limit the current coming out of the gate driver.

Peak HO pullup current is calculated using [Equation 1](#).

$$I_{OHH} = \frac{V_{DD} - V_{DH}}{R_{HOH} + R_{Gate} + R_{GFET\_Int}} = \frac{10V - 1.0V}{1.1V / 100mA + 4.7\Omega + 2.2\Omega} \approx 0.5A$$

where

- $I_{OHH}$  is the peak pullup current
- $V_{DH}$  is the bootstrap diode forward voltage drop
- $R_{HOH}$  is the gate driver internal HO pullup resistance <sup>(1)</sup>
- $R_{Gate}$  is the external gate drive resistance
- $R_{(GFET\_Int)}$  is the MOSFET internal gate resistance, provided by the transistor data sheet

Similarly, Peak HO pulldown current is calculated using [Equation 2](#).

$$I_{OLH} = \frac{V_{DD} - V_{DH}}{R_{HOL} + R_{Gate} + R_{GFET\_Int}}$$

where

- $R_{HOL}$  is the HO pulldown resistance

Peak LO pullup current is calculated using [Equation 3](#).

$$I_{OHL} = \frac{V_{DD}}{R_{LOH} + R_{Gate} + R_{GFET\_Int}}$$

where

- $R_{LOH}$  is the LO pullup resistance

Peak LO pulldown current is calculated using [Equation 4](#).

$$I_{OLL} = \frac{V_{DD}}{R_{LOL} + R_{Gate} + R_{FET\_Int}}$$

where

- $R_{LOL}$  is the LO pulldown resistance

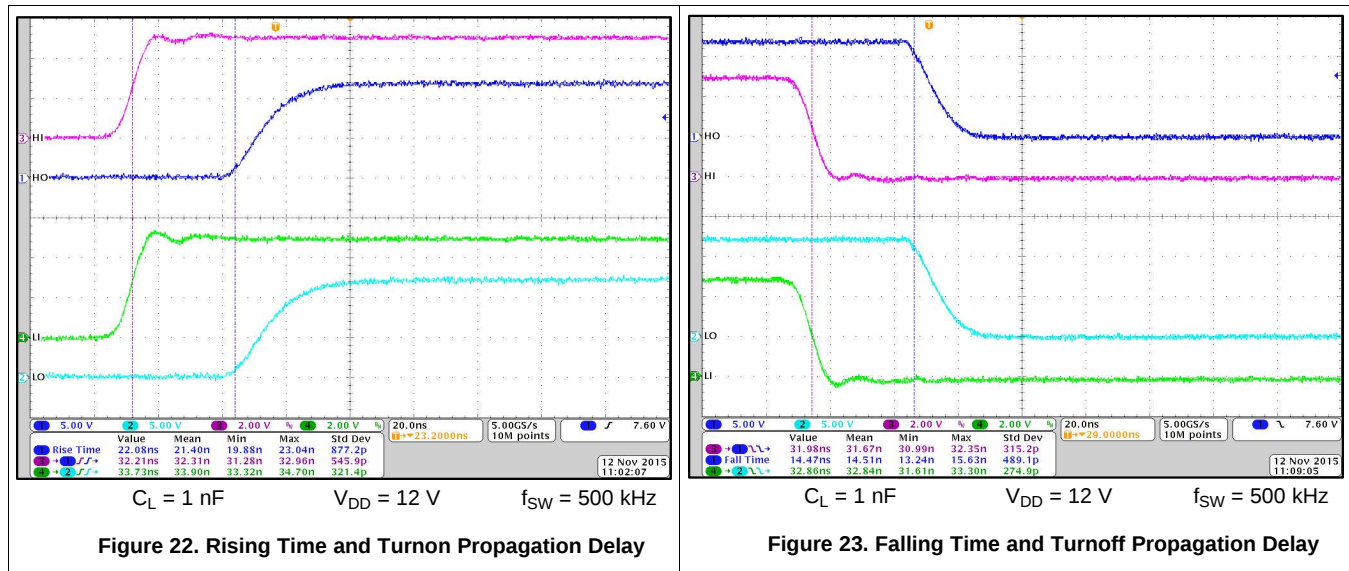
If the application requires fast turnoff, an anti-paralleled diode on  $R_{Gate}$  may be used to bypass the external gate drive resistor and speed up the turnoff transition.

(1) This value is either provided directly by the data sheet or is estimated from the testing conditions using  $R_{HOH} = V_{OHH} / I_{HO}$ .

### 9.2.3 Application Curves

Figure 22 and Figure 23 show the rising and falling time and turnon and turnoff propagation delay testing waveform at room temperature. Each channel (HI, LI, HO, LO) is labeled and displayed on the left hand of the waveform.

The HI and LI pins are shorted together for these test waveforms. Therefore, the propagation delay matching between the channels can be measured and inspected.



## 10 Power Supply Recommendations

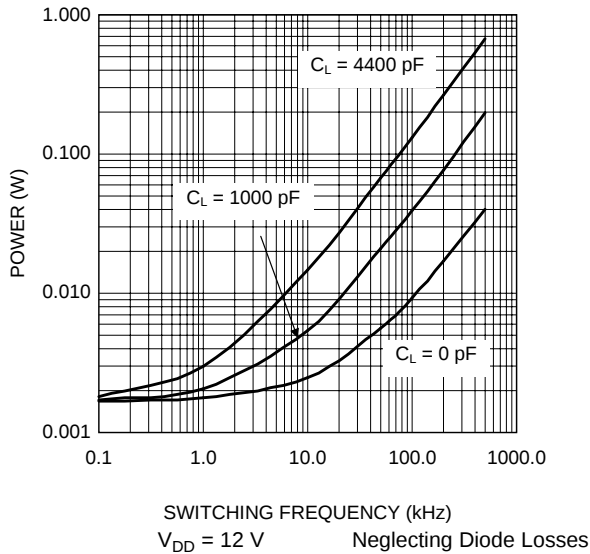
The total IC power dissipation is the sum of the gate driver losses and the bootstrap diode losses. The gate driver losses are related to the switching frequency ( $f$ ), output load capacitance on LO and HO ( $C_L$ ), and supply voltage ( $V_{DD}$ ), which can be roughly calculated using Equation 5.

$$P_{DGATES} = 2 \times f \times C_L \times V_{DD}^2 \quad (5)$$

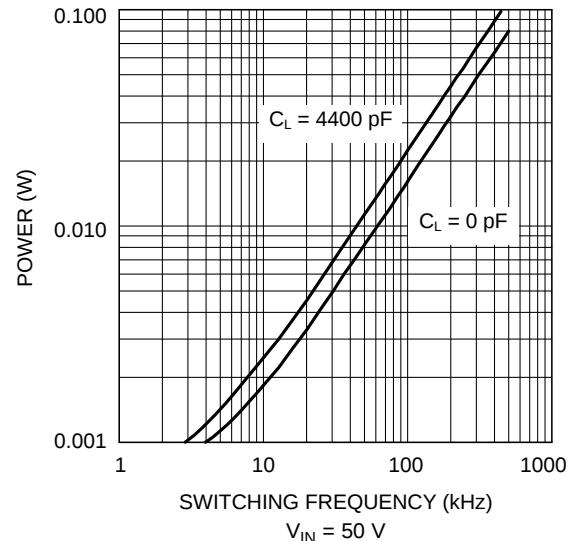
There are some additional losses in the gate drivers due to the internal CMOS stages used to buffer the LO and HO outputs. Figure 24 shows the measured gate driver power dissipation versus frequency and load capacitance. At higher frequencies and load capacitance values, the power dissipation is dominated by the power losses driving the output loads and agrees well with Equation 5. Figure 24 can be used to approximate the power losses due to the gate drivers.

The bootstrap diode power loss is the sum of the forward bias power loss that occurs while charging the bootstrap capacitor and the reverse bias power loss that occurs during reverse recovery. Since each of these events happens once per cycle, the diode power loss is proportional to frequency. Larger capacitive loads require more energy to recharge the bootstrap capacitor resulting in more losses. Higher input voltages ( $V_{IN}$ ) to the half bridge result in higher reverse recovery losses. Figure 25 was generated based on calculations and lab measurements of the diode recovery time and current under several operating conditions and can be used to approximate the diode power dissipation.

The total IC power dissipation can be estimated from these plots by summing the gate drive losses with the bootstrap diode losses for the intended application.



**Figure 24. Gate Driver Power Dissipation (LO + HO)**



**Figure 25. Diode Power Dissipation**

## 11 Layout

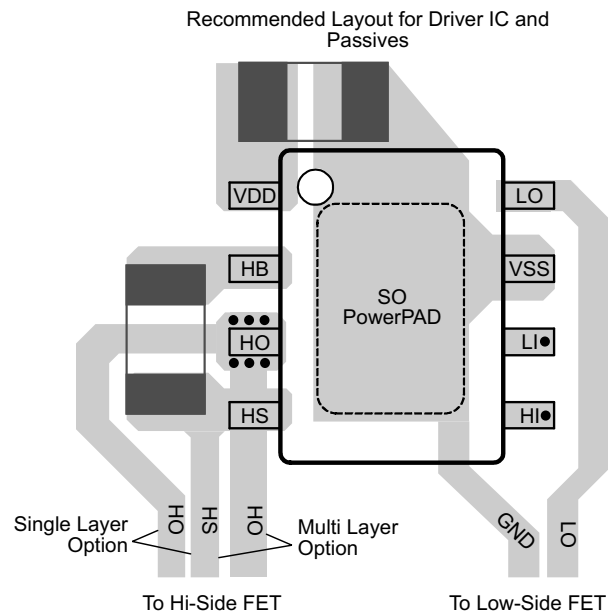
### 11.1 Layout Guidelines

The optimum performance of high and low-side gate drivers cannot be achieved without following certain guidelines during circuit-board layout.

- Low ESR and ESL capacitors must be connected close to the IC, between the VDD and VSS pins and between the HB and HS pins to support the high peak currents being drawn from VDD during start-up of the external MOSFET.
- To prevent large voltage transients at the drain of the top MOSFET, a low ESR electrolytic capacitor must be connected between the MOSFET drain and ground (VSS).
- To avoid large negative transients on the switch node (HS pin), the parasitic inductances must be minimized in the source of the top MOSFET and in the drain of the bottom MOSFET (synchronous rectifier).
- Grounding Considerations:
  - The first priority in designing grounding connections is to confine to a minimal physical area the high peak currents that charge and discharge the MOSFET gate. This decreases the loop inductance and minimizes noise issues on the gate terminal of the MOSFET. The MOSFETs should be placed as close as possible to the gate driver.
  - The second high current path includes the bootstrap capacitor, the bootstrap diode, the local ground referenced bypass capacitor, and low-side MOSFET body diode. The bootstrap capacitor is recharged on a cycle-by-cycle basis through the bootstrap diode from the ground referenced VDD bypass capacitor. The recharging occurs in a short time interval and involves high peak current. Minimizing this loop length and area on the circuit board is important to ensure reliable operation.

Figure 26 shows a recommended layout pattern for the driver. If possible a single layer placement is preferred.

## 11.2 Layout Example



**Figure 26. Recommended Layout Pattern**

## 12 器件和文档支持

### 12.1 接收文档更新通知

如需接收文档更新通知，请访问 [www.ti.com.cn](http://www.ti.com.cn) 网站上的器件产品文件夹。点击右上角的提醒我 (Alert me) 注册后，即可每周定期收到已更改的产品信息。有关更改的详细信息，请查阅已修订文档中包含的修订历史记录。

### 12.2 社区资源

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

**TI E2E™ Online Community** *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At [e2e.ti.com](http://e2e.ti.com), you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

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### 12.4 静电放电警告



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ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

### 12.5 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 13 机械、封装和可订购信息

以下页中包括机械、封装和可订购信息。这些信息是针对指定器件可提供的最新数据。这些数据会在无通知且不对本文档进行修订的情况下发生改变。欲获得该数据表的浏览器版本，请查阅左侧的导航栏。

**PACKAGING INFORMATION**

| Orderable Device   | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|--------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM25101AM/NOPB     | ACTIVE        | SOIC         | D                  | 8    | 95             | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | L25101<br>AM            | <a href="#">Samples</a> |
| LM25101AMR/NOPB    | ACTIVE        | SO PowerPAD  | DDA                | 8    | 95             | RoHS & Green    | SN                                   | Level-3-260C-168 HR  | -40 to 125   | L25101<br>AMR           | <a href="#">Samples</a> |
| LM25101AMRX/NOPB   | ACTIVE        | SO PowerPAD  | DDA                | 8    | 2500           | RoHS & Green    | SN                                   | Level-3-260C-168 HR  | -40 to 125   | L25101<br>AMR           | <a href="#">Samples</a> |
| LM25101AMX/NOPB    | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | L25101<br>AM            | <a href="#">Samples</a> |
| LM25101ASD-1/NOPB  | ACTIVE        | WSO          | NGT                | 8    | 1000           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | 25101A1                 | <a href="#">Samples</a> |
| LM25101ASD/NOPB    | ACTIVE        | WSO          | DPR                | 10   | 1000           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | 25101A                  | <a href="#">Samples</a> |
| LM25101ASDX-1/NOPB | ACTIVE        | WSO          | NGT                | 8    | 4500           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | 25101A1                 | <a href="#">Samples</a> |
| LM25101ASDX/NOPB   | ACTIVE        | WSO          | DPR                | 10   | 4500           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | 25101A                  | <a href="#">Samples</a> |
| LM25101BMA/NOPB    | ACTIVE        | SOIC         | D                  | 8    | 95             | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | L25101<br>BMA           | <a href="#">Samples</a> |
| LM25101BMAX/NOPB   | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | L25101<br>BMA           | <a href="#">Samples</a> |
| LM25101BSD/NOPB    | ACTIVE        | WSO          | DPR                | 10   | 1000           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | 25101B                  | <a href="#">Samples</a> |
| LM25101BSDX/NOPB   | ACTIVE        | WSO          | DPR                | 10   | 4500           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | 25101B                  | <a href="#">Samples</a> |
| LM25101CMA/NOPB    | ACTIVE        | SOIC         | D                  | 8    | 95             | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | L25101<br>CMA           | <a href="#">Samples</a> |
| LM25101CMAX/NOPB   | ACTIVE        | SOIC         | D                  | 8    | 2500           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | L25101<br>CMA           | <a href="#">Samples</a> |
| LM25101CMY/NOPB    | ACTIVE        | HVSSOP       | DGN                | 8    | 1000           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | CMYN                    | <a href="#">Samples</a> |
| LM25101CMYE/NOPB   | ACTIVE        | HVSSOP       | DGN                | 8    | 250            | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | CMYN                    | <a href="#">Samples</a> |
| LM25101CMYX/NOPB   | ACTIVE        | HVSSOP       | DGN                | 8    | 3500           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | CMYN                    | <a href="#">Samples</a> |
| LM25101CSD/NOPB    | ACTIVE        | WSO          | DPR                | 10   | 1000           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | 25101C                  | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM25101CSDX/NOPB | ACTIVE        | WSO          | DPR                | 10   | 4500           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | 25101C                  | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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## TAPE AND REEL INFORMATION



\*All dimensions are nominal

| Device             | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM25101AMRX/NOPB   | SO Power PAD | DDA             | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM25101AMX/NOPB    | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM25101ASD-1/NOPB  | WSO          | NGT             | 8    | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM25101ASD/NOPB    | WSO          | DPR             | 10   | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM25101ASDX-1/NOPB | WSO          | NGT             | 8    | 4500 | 330.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM25101ASDX/NOPB   | WSO          | DPR             | 10   | 4500 | 330.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM25101BMAX/NOPB   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM25101BSD/NOPB    | WSO          | DPR             | 10   | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM25101BSDX/NOPB   | WSO          | DPR             | 10   | 4500 | 330.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM25101CMAX/NOPB   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM25101CMY/NOPB    | HVSSOP       | DGN             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LM25101CMYE/NOPB   | HVSSOP       | DGN             | 8    | 250  | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LM25101CMYX/NOPB   | HVSSOP       | DGN             | 8    | 3500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LM25101CSD/NOPB    | WSO          | DPR             | 10   | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM25101CSDX/NOPB   | WSO          | DPR             | 10   | 4500 | 330.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

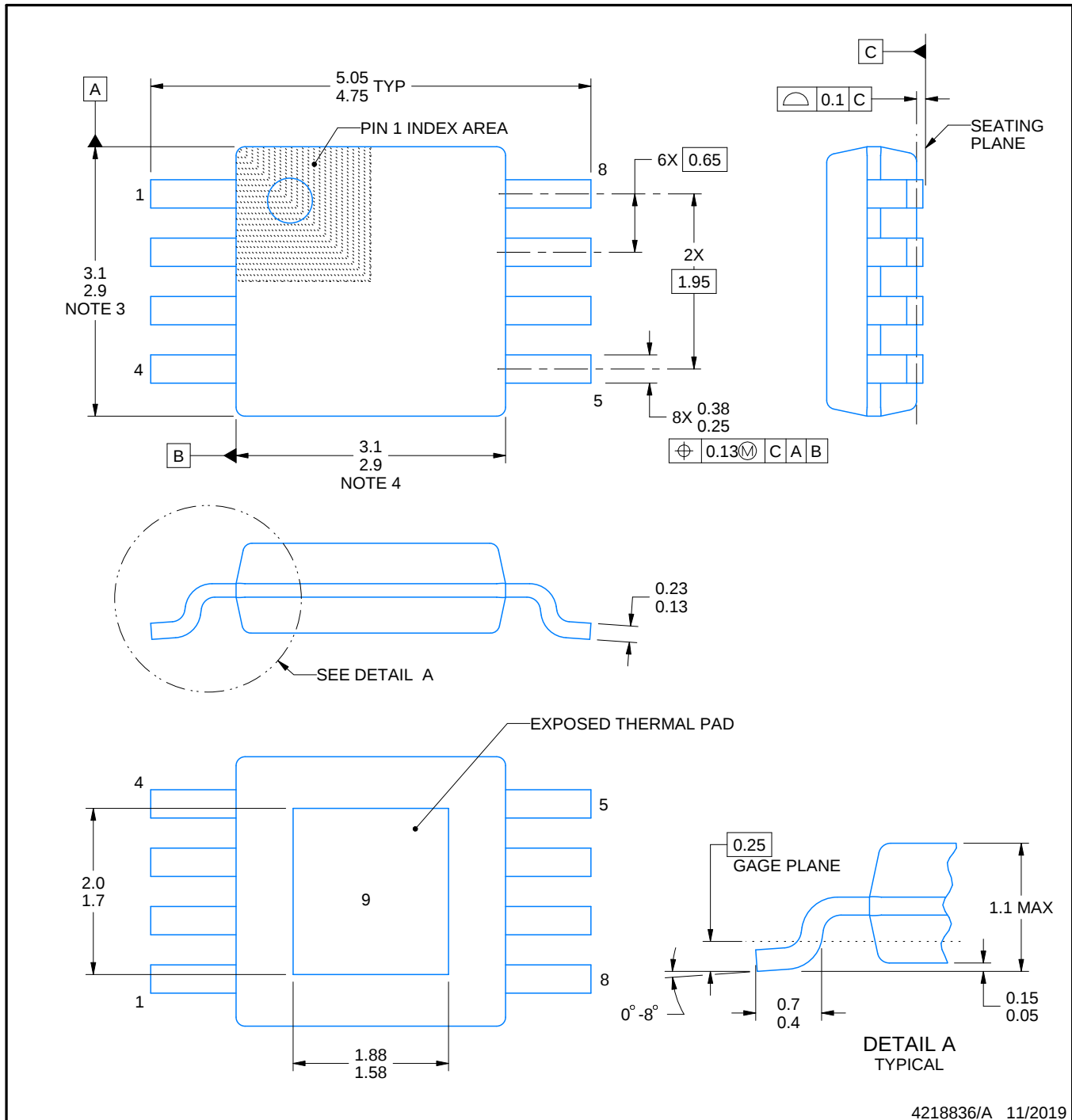
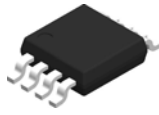
| Device             | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM25101AMRX/NOPB   | SO PowerPAD  | DDA             | 8    | 2500 | 853.0       | 449.0      | 35.0        |
| LM25101AMX/NOPB    | SOIC         | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM25101ASD-1/NOPB  | WSON         | NGT             | 8    | 1000 | 210.0       | 185.0      | 35.0        |
| LM25101ASD/NOPB    | WSON         | DPR             | 10   | 1000 | 210.0       | 185.0      | 35.0        |
| LM25101ASDX-1/NOPB | WSON         | NGT             | 8    | 4500 | 367.0       | 367.0      | 35.0        |
| LM25101ASDX/NOPB   | WSON         | DPR             | 10   | 4500 | 367.0       | 367.0      | 35.0        |
| LM25101BMAX/NOPB   | SOIC         | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM25101BSD/NOPB    | WSON         | DPR             | 10   | 1000 | 210.0       | 185.0      | 35.0        |
| LM25101BSDX/NOPB   | WSON         | DPR             | 10   | 4500 | 367.0       | 367.0      | 35.0        |
| LM25101CMAX/NOPB   | SOIC         | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM25101CMY/NOPB    | HVSSOP       | DGN             | 8    | 1000 | 210.0       | 185.0      | 35.0        |
| LM25101CMYE/NOPB   | HVSSOP       | DGN             | 8    | 250  | 210.0       | 185.0      | 35.0        |
| LM25101CMYX/NOPB   | HVSSOP       | DGN             | 8    | 3500 | 367.0       | 367.0      | 35.0        |
| LM25101CSD/NOPB    | WSON         | DPR             | 10   | 1000 | 210.0       | 185.0      | 35.0        |
| LM25101CSDX/NOPB   | WSON         | DPR             | 10   | 4500 | 367.0       | 367.0      | 35.0        |

## TUBE



\*All dimensions are nominal

| Device          | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-----------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| LM25101AM/NOPB  | D            | SOIC         | 8    | 95  | 495    | 8      | 4064   | 3.05   |
| LM25101AMR/NOPB | DDA          | HSOIC        | 8    | 95  | 495    | 8      | 4064   | 3.05   |
| LM25101BMA/NOPB | D            | SOIC         | 8    | 95  | 495    | 8      | 4064   | 3.05   |
| LM25101BMA/NOPB | D            | SOIC         | 8    | 95  | 495    | 8      | 4064   | 3.05   |
| LM25101CMA/NOPB | D            | SOIC         | 8    | 95  | 495    | 8      | 4064   | 3.05   |



4218836/A 11/2019

## NOTES:

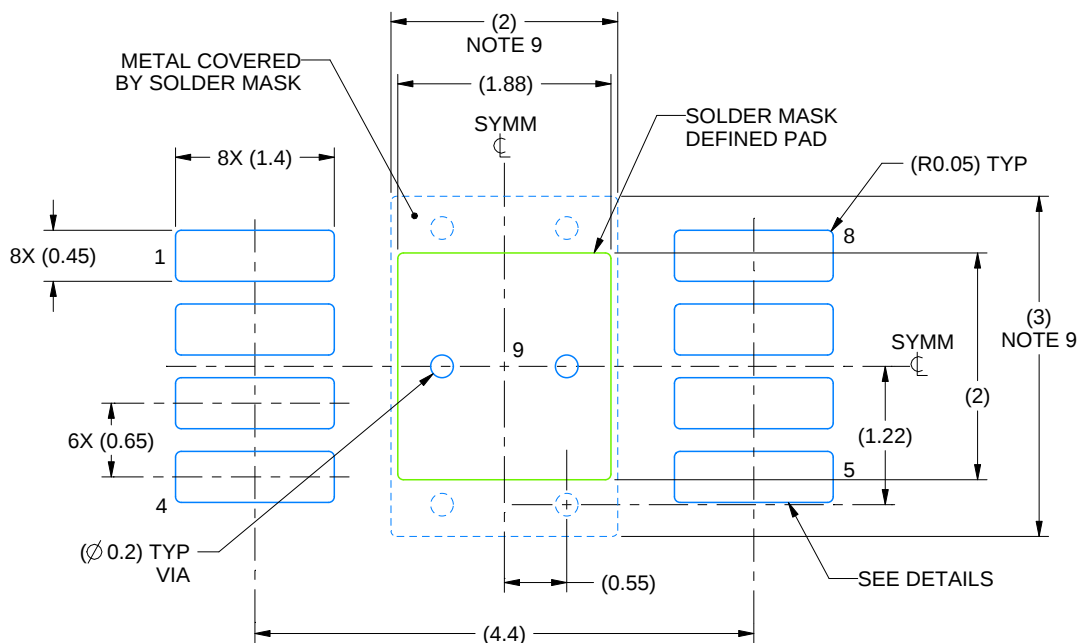
PowerPAD is a trademark of Texas Instruments.

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187.

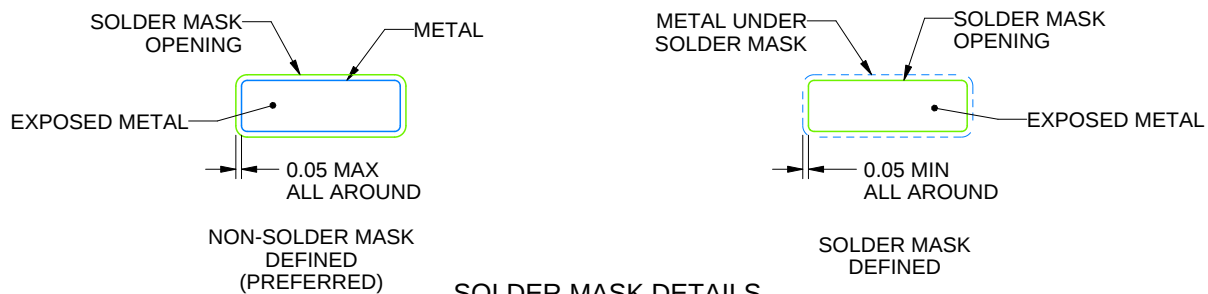
**DGN0008A**

## PowerPAD™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 15X



## SOLDER MASK DETAILS

4218836/A 11/2019

NOTES: (continued)

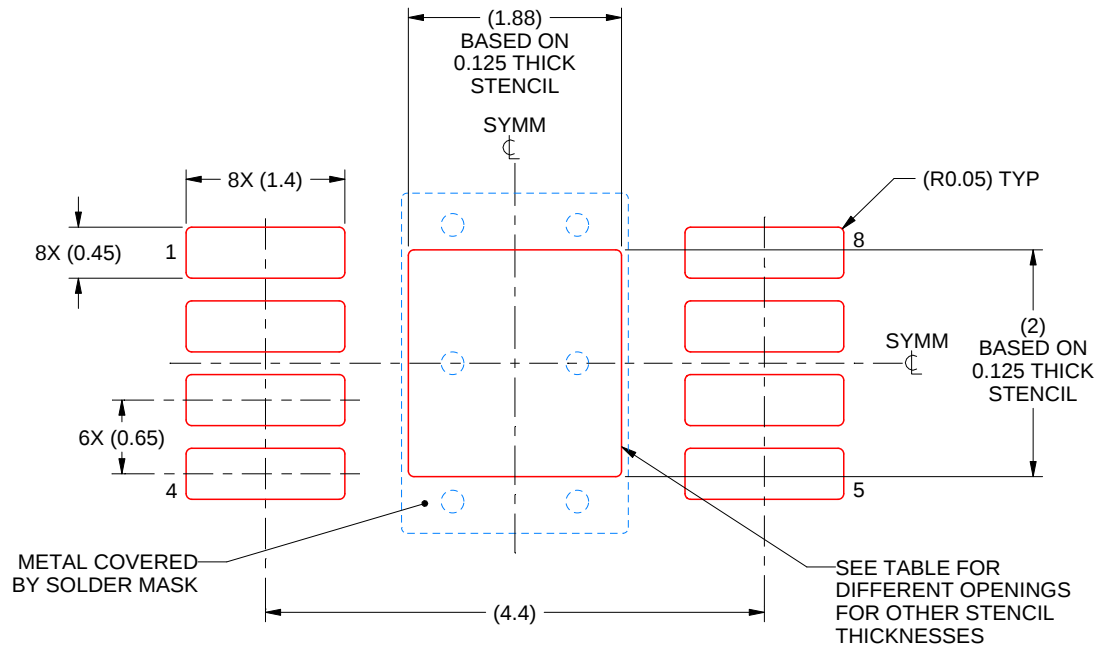
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.
9. Size of metal pad may vary due to creepage requirement.

# EXAMPLE STENCIL DESIGN

DGN0008A

PowerPAD™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



**SOLDER PASTE EXAMPLE**  
EXPOSED PAD 9:  
100% PRINTED SOLDER COVERAGE BY AREA  
SCALE: 15X

| STENCIL THICKNESS | SOLDER STENCIL OPENING |
|-------------------|------------------------|
| 0.1               | 2.10 X 2.24            |
| 0.125             | 1.88 X 2.00 (SHOWN)    |
| 0.15              | 1.72 X 1.83            |
| 0.175             | 1.59 X 1.69            |

4218836/A 11/2019

NOTES: (continued)

10. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
11. Board assembly site may have different recommendations for stencil design.

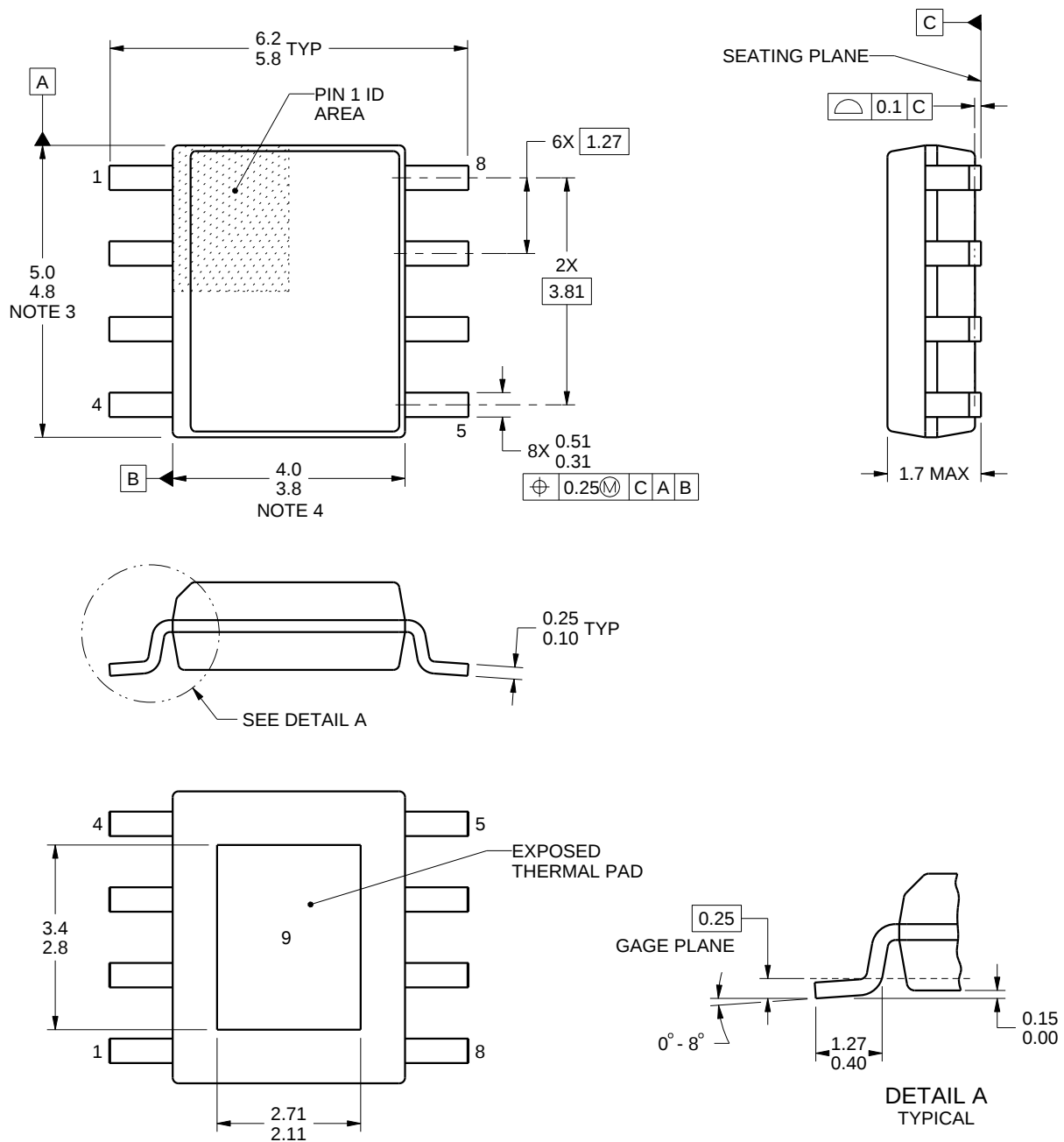
DDA0008B



# PACKAGE OUTLINE

PowerPAD™ SOIC - 1.7 mm max height

PLASTIC SMALL OUTLINE



4214849/A 08/2016

## NOTES:

PowerPAD is a trademark of Texas Instruments.

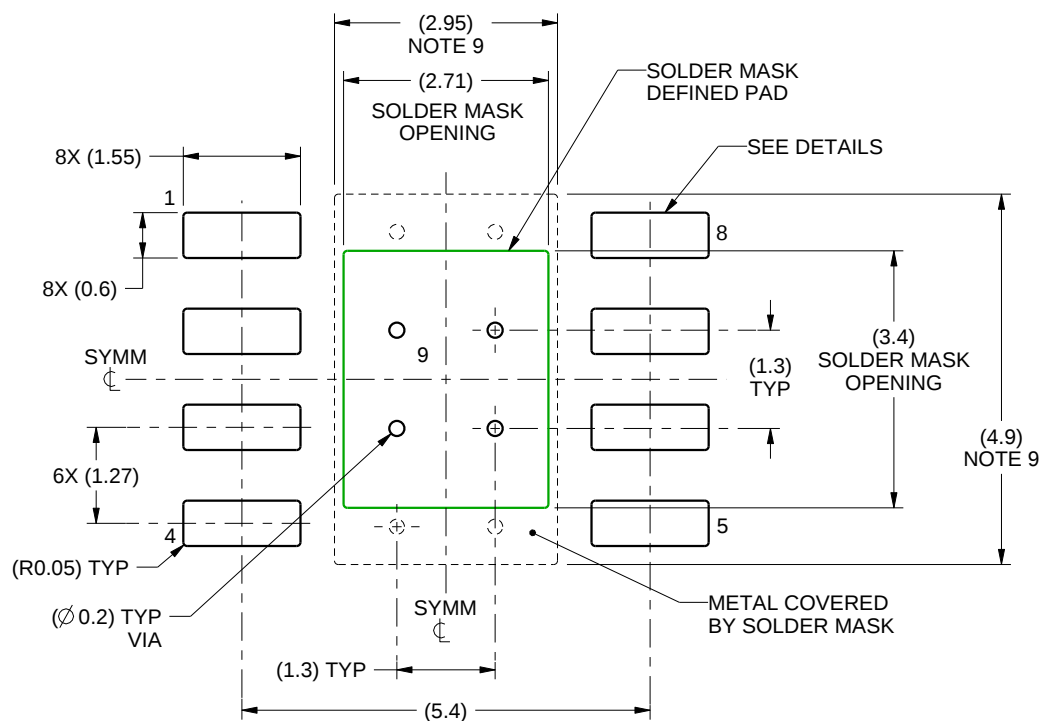
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MS-012.

# EXAMPLE BOARD LAYOUT

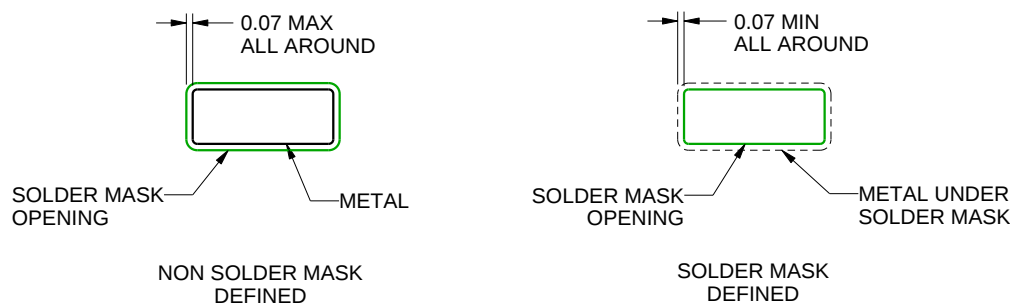
DDA0008B

PowerPAD™ SOIC - 1.7 mm max height

PLASTIC SMALL OUTLINE



LAND PATTERN EXAMPLE  
SCALE:10X



SOLDER MASK DETAILS  
PADS 1-8

4214849/A 08/2016

NOTES: (continued)

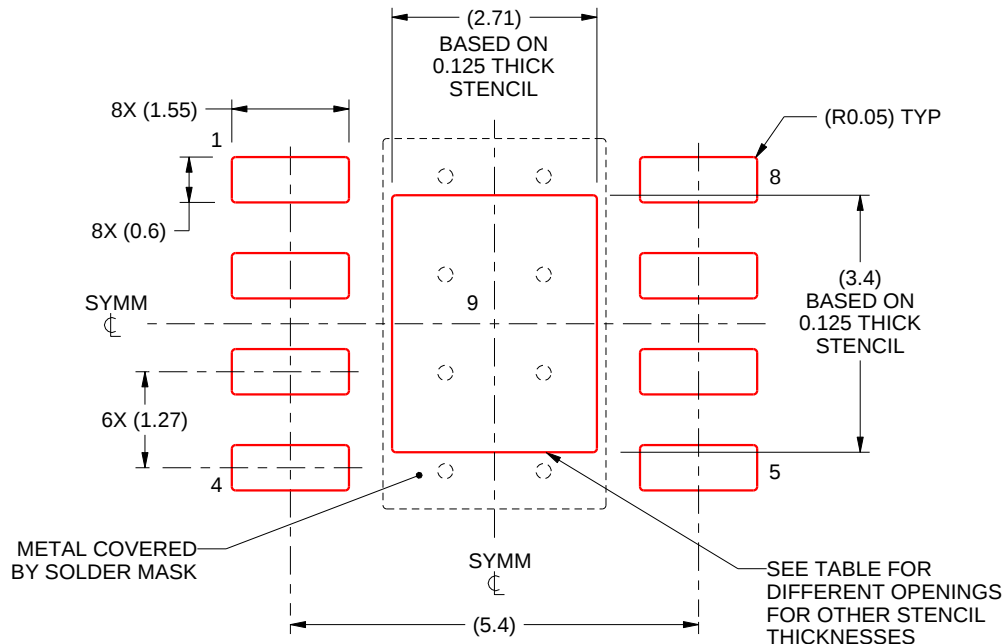
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature numbers SLMA002 ([www.ti.com/lit/slma002](http://www.ti.com/lit/slma002)) and SLMA004 ([www.ti.com/lit/slma004](http://www.ti.com/lit/slma004)).
9. Size of metal pad may vary due to creepage requirement.
10. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

# EXAMPLE STENCIL DESIGN

DDA0008B

PowerPAD™ SOIC - 1.7 mm max height

PLASTIC SMALL OUTLINE



SOLDER PASTE EXAMPLE  
EXPOSED PAD  
100% PRINTED SOLDER COVERAGE BY AREA  
SCALE:10X

| STENCIL THICKNESS | SOLDER STENCIL OPENING |
|-------------------|------------------------|
| 0.1               | 3.03 X 3.80            |
| 0.125             | 2.71 X 3.40 (SHOWN)    |
| 0.150             | 2.47 X 3.10            |
| 0.175             | 2.29 X 2.87            |

4214849/A 08/2016

NOTES: (continued)

11. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
12. Board assembly site may have different recommendations for stencil design.



**WSON - 0.8 mm max height**

PLASTIC SMALL OUTLINE - NO LEAD

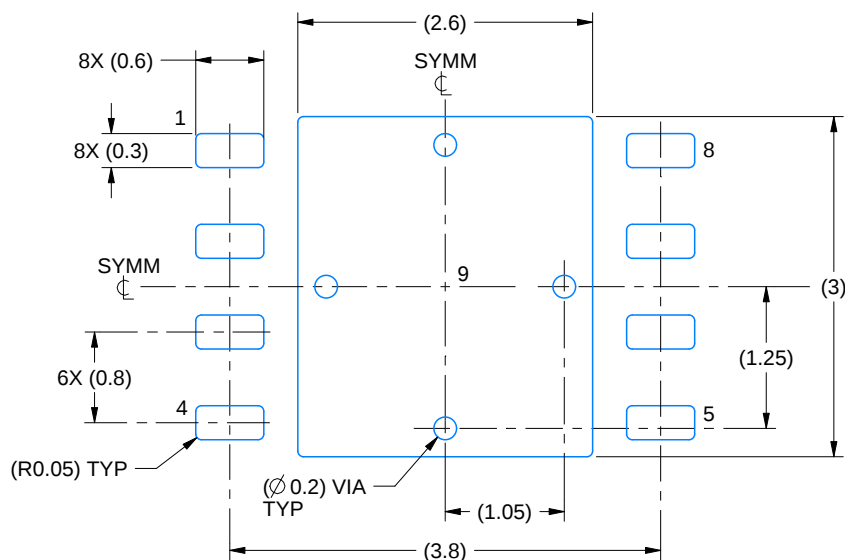


1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

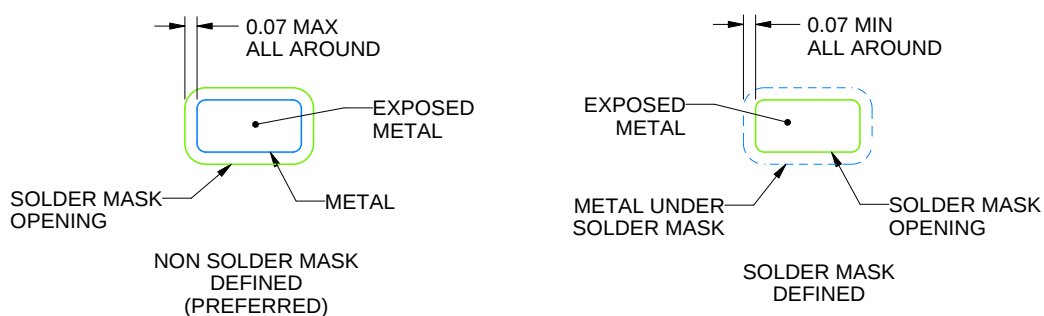
**NGT0008A**

**WSN - 0.8 mm max height**

PLASTIC SMALL OUTLINE - NO LEAD



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:15X



## SOLDER MASK DETAILS

4214935/A 08/2020

NOTES: (continued)

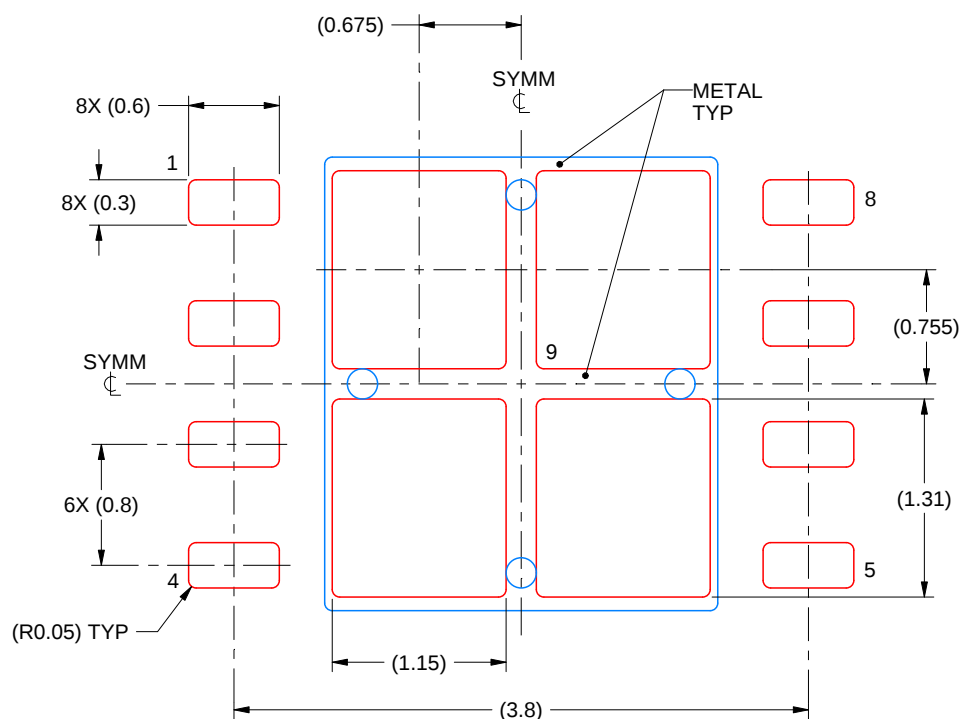
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/slua271](http://www.ti.com/lit/slua271)).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

# EXAMPLE STENCIL DESIGN

NGT0008A

WSN - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



4214935/A 08/2020

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.



## PACKAGE OUTLINE

**SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.

**D0008A**

**SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:8X



## SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

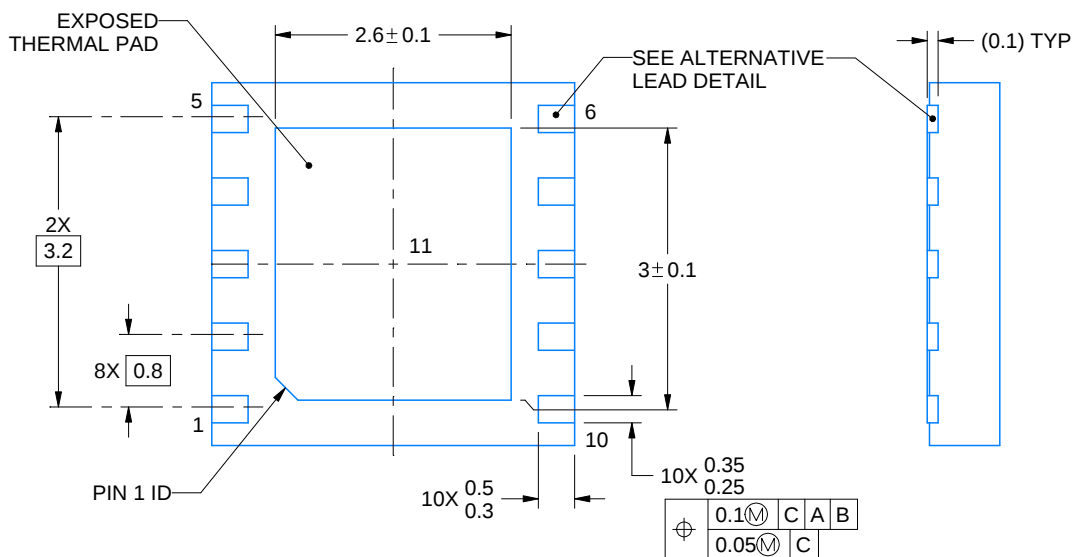
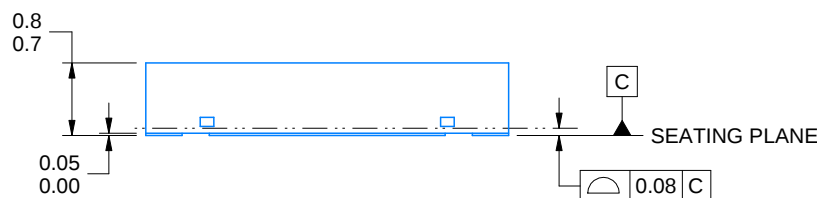
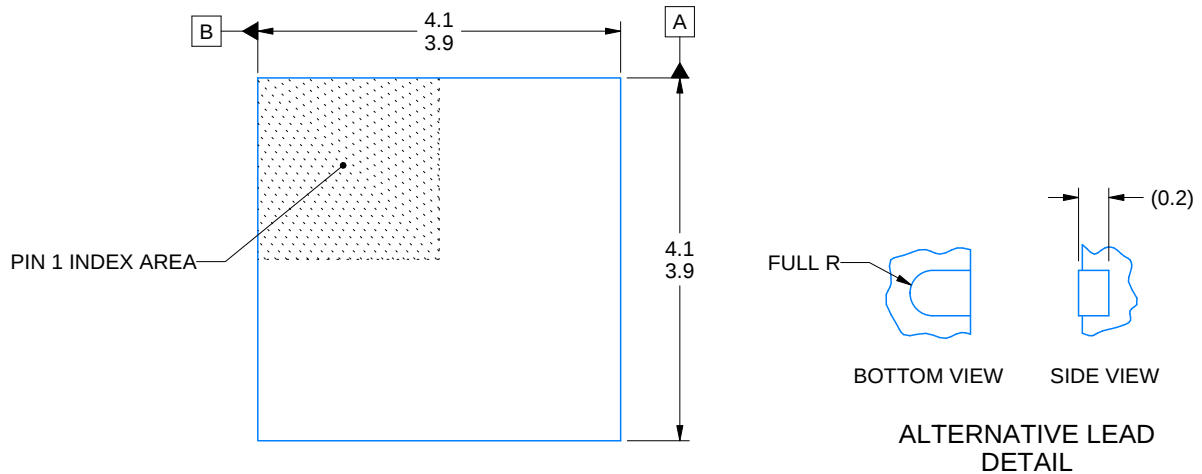
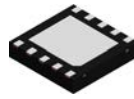


SOLDER PASTE EXAMPLE  
BASED ON .005 INCH [0.125 MM] THICK STENCIL  
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.



4218856/B 01/2021

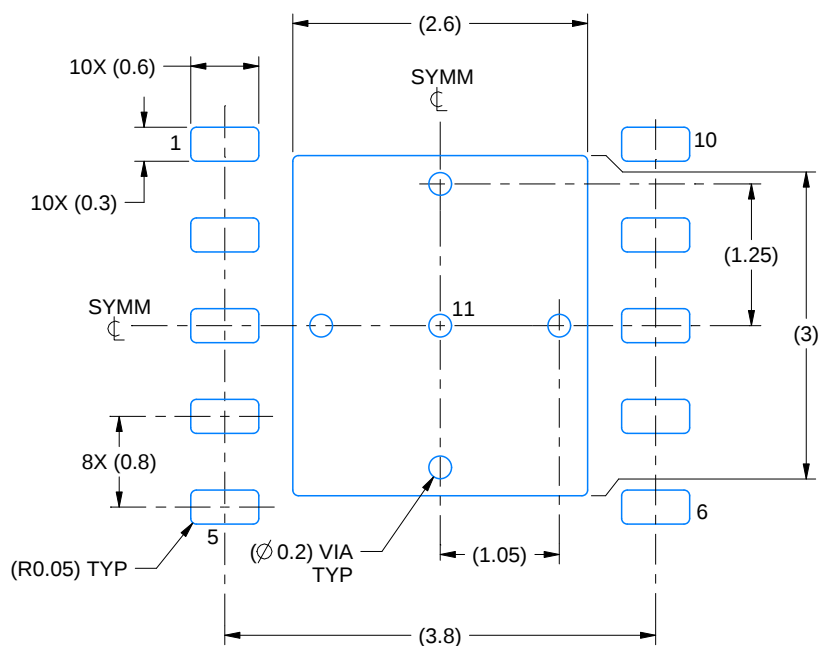
## NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

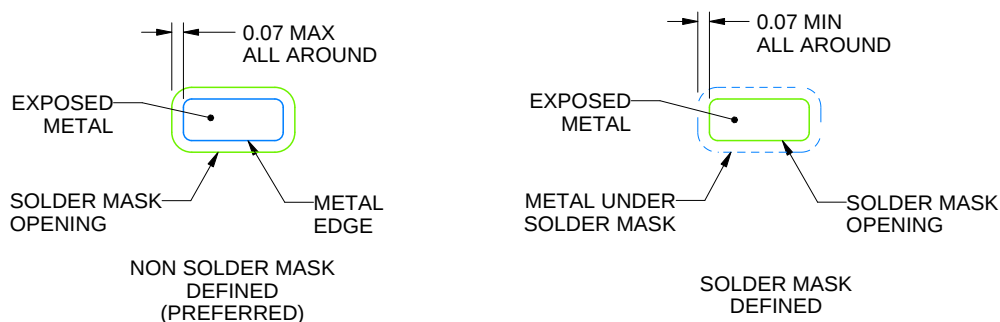
**DPR0010A**

**WSON - 0.8 mm max height**

PLASTIC SMALL OUTLINE - NO LEAD



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:15X



## SOLDER MASK DETAILS

4218856/B 01/2021

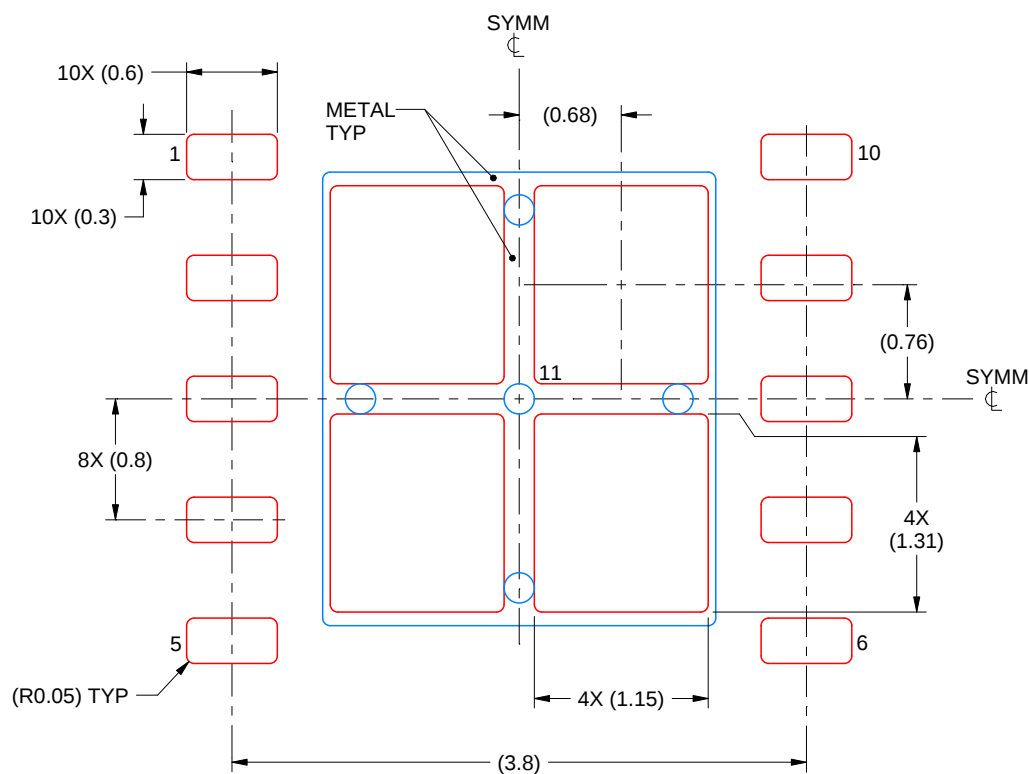
NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/slua271](http://www.ti.com/lit/slua271)).

**DPR0010A**

**WSON - 0.8 mm max height**

PLASTIC SMALL OUTLINE - NO LEAD



## SOLDER PASTE EXAMPLE BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD 11:  
77% PRINTED SOLDER COVERAGE BY AREA  
SCALE:20X

4218856/B 01/2021

NOTES: (continued)

5. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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